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TROPICAL AGRICULTURE is published monthly at the Imperial College of Tropical Agriculture, St. Augustine, Trinidad, West Indies. Advertisement and subscription rates can be obtained at the College from the Editor, or from the Secretary of the College, 14, Trinity Square, London, E.C.3, England. The Editor will be glad to consider authoritative articles for publication. It is understood that opinions expressed or recommendations made in signed articles or in articles of which the source is named are those of the author and do not necessarily represent the policy or opinion of the College Authorities. Increasing numbers of inquiries are being received from the various parts of the tropics which can be answered only by persons possessed of an intimate knowledge of local conditions. Enquirers should first satisfy themselves that their local Department of Agriculture is not able to supply them with the desired information before communicating with us. Correspondence which will be replied to is invited on all other matters pertaining to tropical agriculture, science and development.

WEST INDIAN SUGAR ASSOCIATION.

THE formation of a Sugar Technologists' Association in the British West Indies has been under consideration for some time but it is only recently that the idea has taken concrete form. Among the more recent advocates are Mr. Scott, former Professor of Sugar Technology at the College who, in an address to the Conference of West Indian Agricultural Officers, six years ago, pointed out the desirability of forming such an Association and the West Indian Sugar Commission comprising Lord Olivier and Mr. Semple. It was left, however, to Mr. Cecil W. Murray to take the action necessary to bring the West Indian sugar interests together to participate in a preliminary discussion. The Conference before which Mr. Scott laid his views endorsed his suggestion and stressed that the term "technologist" should be used in its wider sense and should include all those interested in the production of sugar, whether their activities be in the field, the factory, office or laboratory. The West Indian Commission in its report stated: "For the improvement of the technique of the industry as a whole we advocate the formation of a Sugar Technologists' Association, as has been done in all progressive sugar-producing countries to-day, including Cuba, Java, Hawaii, Natal, and recently India, whereby comparative reports may be exchanged, technical papers read and discussed at an annual meeting, and all producers—agriculturists, transport workers, and factory operators—may more fully realise that collective work and co-operation will produce more rapid advance than the present individualistic methods. Such an Association will probably not be self-supporting and might reasonably receive some assistance from public funds. In other countries these Associations are assisted by donations from the factory-owners, who recognise the great advantage such an organization is to their business". Further in the report it is pointed out that "There is a very outstanding example of the value of, and the necessity for, some system of circulating weekly or fortnightly comparative reports among the factories of the British West Indies, in inculcating a spirit of friendly rivalry among the operators and generally improving the technique of the industry. There are four central factories controlled by the same financial group in London, one factory in each of the islands of Antigua, St. Kitts, Trinidad and Jamaica. Comparative

reports are circulated to each factory, and the fact that the lowest recovery reported by this group exceeds the highest recovery of factories outside the group is a conclusive proof of the value of this system".

"Owing to the isolated positions of many factories and the individualistic tendencies of the owners and operators, there is a rather general lack of knowledge of modern developments and practice which could, to a large degree be corrected by fostering a competitive spirit through a West Indian Sugar Association . . . Such an Association might well have its headquarters in Trinidad, where we were assured the co-operation of the staff of the Imperial College of Tropical Agriculture would be freely given. In this way a point of contact would be established between the staff and research workers at the College and the operating personnel of the factories which would be of great value to all concerned. In addition to circulating comparative reports, an Association should have, at least annually, meetings of the members for the presentation and discussion of papers on the various phases and developments of the technical work of field, transport and factory. Much has already been done by other Associations and Societies in various countries, but the papers of these Associations, although widely quoted in various technical journals, do not appear to reach a large proportion of West Indian sugar producers. The preparation of papers by individual technologists in the West Indies, which would require correspondence and consultation with others interested in the particular phase of the work, would arouse general interest. Also, papers dealing with the work in the Colonies, if printed and distributed to all members, would probably be read where papers prepared for other Associations might be laid aside as not applicable to West Indian conditions."

It will thus be seen that considerable attention has been paid to the question of forming a British West Indian Sugar Technologists' Association but no definite action was actually taken until the publication of Mr. Cecil Murray's letter on the subject in a recent issue of the *West India Committee Circular*. As a result of this letter a well represented meeting of persons interested in the West Indian sugar industry was held early in September at the offices of the West India Committee to discuss Mr. Murray's proposals and we are glad to learn that a strong Committee has now been formed to consider and make recommendations with a view to the early establishment of the Association. We are glad also to note that the proposed Association will not in any way clash with existing associations, nor with Colonial Departments of Agriculture, nor with the work of the Imperial College of Tropical Agriculture. On the contrary it is anticipated that it will be of considerable assistance to these various institutions as it will enable complementary tests on a field or factory scale to be carried out in close collaboration with them.

The chief object of the Association will no doubt be to promote discussions of technical problems in both field and factory and by so doing to effect that closer liaison which is so desirable between these two sides of the sugar industry. In this connection many subjects could be covered among the more important of which might be mentioned uniformity in reporting factory data; factory operation and chemical control; cultivation and field operations; cane breeding; cane pests and diseases; and soil and fertilizer work. It is obvious that an exchange of new information and ideas on these subjects as they affect local conditions can only lead eventually to greater efficiency in all departments of sugar production in the British West Indies. Further, as suggested by the West Indian Sugar Commission the Association's headquarters might conveniently be situated in Trinidad where the Imperial College of Tropical Agriculture, as a research and teaching centre, offers certain facilities not obtainable elsewhere. Moreover, since the proposals for the formation of the Association have emanated from West Indian sugar interests it is not unreasonable to expect that they will be prepared to finance its work and we hope, therefore, that the necessary funds for supporting a movement which can only be of great benefit to the industry as a whole, may be forthcoming.

USES OF COTTONSEED.

For some time oil has been extracted from cottonseed, but the procedures used have, as a rule, been expensive, because of the cost of apparatus, motive power, manual labour, and particularly, upkeep. A simpler and more economical method of extracting the oil has been devised in the Congo. The seeds are ground coarsely as they come from the gin. The ground material is passed through a sieve to separate the kernels from the husks. The latter can be used as a second-grade fertilizer or can be made into fuel bricks.

The kernels are reground and the cottonseed meal which is obtained is moistened and heated. The substance is placed in baskets pierced with holes and is compressed under hydraulic presses of the same type as those used in baling the ginned cotton. The cottonseed oil is collected and the cottonseed cakes which remain constitute an excellent cattle food. The cakes can also be used for fuel.

The weight of extracted oil represents from 10 to 15 per cent. of the weight of the seed. The cost of production is about 50 centimes per kilogram. The process is also significant from the standpoint of apparatus, since it requires only the equipment already used in the cotton industry. The cottonseed oil thus obtained can be used at once in fixed Diesel engines, as well as in automotive vehicles, for it is not necessary for the oil to be refined.—(*Industrial and Eng. Chem.*, News Edition, Vol. XIV, No. 17, p. 345, 1936).

SOME ASPECTS OF CACAO SOIL FERTILITY IN TRINIDAD.

By F. Hardy.
(*Imperial College of Tropical Agriculture.*)

Cacao is grown in Trinidad solely as a forest crop, that is, soil tillage is rarely, if ever, practised, and the trees are produced by undisturbed soil that formerly supported natural forest vegetation. Such soil possesses characteristic features when examined in profile, the most striking feature being the occurrence of a distinctive surface layer, seldom more than six inches thick, rich in organic matter and plant nutrients, and superior in moisture-supplying ability, aeration and physical structure to the soil lying below.

The chemical and physical properties of the subsoil layers usually depreciate rapidly with depth, until the decomposing parent rock is reached, at distances varying between two and six or more feet below ground level.

The Main Types of Soil Occurring in Trinidad.

The mineralogical composition of the parent rock differs considerably according to the geological formation. The most usual type of rock in Trinidad is sandy, silty or clayey sedimentary material that may have been repeatedly weathered, reworked and redeposited in water before its present-day bedding was imposed upon it. It is therefore generally deficient in potential plant nutrient mineral substances. There are some exceptions to these generalisations, and one of the objects of soil survey work is to classify the parent soil-forming rocks according to their mineralogical and chemical characters, and to ascertain the thickness of the intermediate, nutrient-deficient, "dead" layer, lying between the fertile surface organic soil and the decomposing parent rock material. Already a considerable mass of information has been accumulated, which should render possible such precise classification and description. Eventually, when the main soil-types have been differentiated and named, these features of the profile will be given due prominence, for they decide the *degree of permanence of fertility* which the differing soil-types possess; they are fundamental values in the assessment of land utility.

In certain, though not wide-spread, areas in Trinidad, cacao has been planted on soil which previously supported some other less-exacting crop, for example, sugar-cane. Such cases are much more common, however, in Grenada and Tobago. There the chief type of soil-forming rock is igneous or volcanic, whose component minerals have not been subjected to profound weathering, and whose mineral assemblages are primary*, rather than secondary products, and therefore inherently rich in potential plant mineral nutrients, notably, potash, phosphate and lime. These *volcanic soils* consequently show a comparatively high degree of permanence of fertility, and some of them would appear to be almost inexhaustible. They support good cacao crops, in spite of the fact that they had previously produced a great many profitable crops of sugar-cane in years gone by.

Apart from soils derived from volcanic rocks, two other soil types possessing appreciable permanence of fertility, occur in Trinidad, Grenada and Tobago. They are certain calcareous soils and certain geologically-recent alluvial soils, whose parent rocks belong to the sedimentary group.

By *calcareous soil* is meant a soil derived from a parent rock initially containing abundant calcium carbonate, such as limestone and marl. Well-known examples in Trinidad are the famous Chocolate Soil of the Montserrat District, and the widespread Princes Town Marl Soil occurring in the Naparima District lying between the Central and the Southern Mountain Ranges. Whilst calcareous soils are generally rich and continuously productive, certain kinds are too shallow and stony to provide a suitable medium for the growth of tree crops, and their water-supplying ability is inadequate for the satisfactory development of shallow-rooted plants, which consequently suffer drought in dry seasons. Some calcareous soils are also deficient in one or other of the main plant nutrients, and their surface layers may be appreciably acidic in reaction. Thus, the Princes Town Marl black clay soil is notably deficient in phosphate, although its other attributes appear to be excellent.

The recent *alluvial soils* originated from materials that have been continuously deposited by flood water along the banks of rivers, or in lagoon basins and deltas. Much of this sedimentary material has been washed from the surrounding hill slopes, and therefore may comprise humic soil in which plant nutrient substances have been more-or-less firmly fixed as "exchangeable" or "surface-combined" bases. The fertility of alluvial soils thus depends partly on the nature of the sedimentary material, and partly on the content of organic matter in the successive layers of the profile. Consequently they may be classified into "good", "medium" and "poor" alluvial soils, and only the better kinds are able to support satisfactory crops of cacao. Examples of good alluvial soils in Trinidad are some of the valley soils of the Northern Range, whilst

* *Note.*—"Primary" minerals include (*a*) *felspars*, containing abundant potash, lime or soda, (*b*) *ferromagnesian minerals*, containing lime, magnesia, iron and frequently potash, (*c*) *apatite*, consisting of calcium phosphate, (*d*) *micas*, containing potash, soda, magnesia and iron. "Secondary" minerals include (*a*) *kaolin*, containing little else but aluminia and silica, (*b*) *iron oxides*, which impart red and brown colours, (*c*) *calcite* (calcium carbonate), (*d*) *gypsum* (calcium sulphate).

examples of poor alluvial soils are certain of the swamp and lagoon soils occurring in the sugar-cane lands of the Northern Plain, which yield satisfactory crops only when properly limed and manured. Intermediate kinds form river " vegas" ramifying widespread over the Northern Plain, particularly in the Sangre Grande District.

Many of the poorer alluvial soils are highly acidic, phosphate-deficient and inclined to swampiness and water-logging. They are generally clayey in texture. On the other hand, the better alluvial soils, such as those of the Northern Range, are sandy in texture, less acidic, and potash-deficient rather than phosphate-deficient. They are less prone to water-logging, and their natural underdrainage is generally satisfactory.

The Importance of the Different Layers.

It has been mentioned above that the most conspicuous feature of the profile in the majority of the soil-types derived from sedimentary parent rocks in Trinidad is the distinctive surface layer, seldom exceeding six inches in thickness. This layer usually contains more than twice as much organic matter, nitrogen, and available phosphate and potash as the next 6-inch layer lying immediately below it, and this second layer is similarly richer than the third 6-inch layer. Further down the profile, nutrient conditions may improve again as the decomposing parent rock is approached, but the rotting rock material at these lower depths is devoid of organic matter and nitrogen, and cannot therefore be regarded as a suitable and complete medium for plant growth.

How far the deep-seated material contributes to the nutrition of crop plants cannot be conjectured. There is great need of detailed investigations of the rôle of these lower layers in crop production. Frequently the deeper subsoil contains living roots, even when the crop is sugar-cane, which usually is regarded as essentially a shallow-rooted plant. Many tree crops possess deep tap roots, and in most cases, a certain number of persistent secondary roots penetrate deeply into the decomposing parent rock, the depth of penetration depending on such factors as the degree of mechanical resistance of the material, the presence of cracks which permit subsoil aeration, inter-grain porosity, and the normal depth of the water-table. Subsoil investigations should take into consideration all these factors, as well as the natural tendency of the particular crop to produce deep roots in addition to the usual mass of surface-feeding roots that appears to distinguish most crop plants, such as cacao, that thrive under humid tropical conditions.

Conditions in Natural Forests.

Under natural forest conditions, a circulating system is established by the growing trees, whose deeper roots elevate ground-water containing soluble salts derived from the decomposing rock. The dilute solution is transported up the stems and trunks into the developing foliage, where some of the elements are fixed whilst others remain dissolved in the cell sap of the foliar tissues. When the leaves are subsequently shed, the mineral substances are returned to the soil, but their concentration is confined entirely to the upper layer, which thus becomes progressively enriched in mineral nutrient substances. Much of this mineral material is utilised for the nutrition of new generations of plants, whilst further contributions are provided by the deep-seated soil. Eventually the subsoil is depleted of the greater part of its soluble nutrient substances, and the dimensions of the exhausted or " dead " layer becomes too great to play a significant part in the nutrition process. The decomposing parent rock may now be quite out of reach of the majority of the deeper roots, and even its store of water may be of little use to plants, excepting where the water-table shows regular seasonal fluctuations. Rising ground water may periodically bring water and nutrient supplies within easy reach of the main mass of roots, but only under exceptional circumstances of soil and plant may the process be relied upon to provide a permanent source of moisture and nutrients.

The inter-relations between the growing plant and the conditions in the soil down to the lowest depths are notoriously complicated. A state of equilibrium is eventually established under natural circumstances when soil conditions remain undisturbed. A definite assemblage of plants, living in complete harmony with the prevailing conditions, finally arises as a sort of " climax " vegetation, whose occurrence over a considerable area is regarded by the forest ecologist as indicative of the existence of a particular set of growth factors. It is not always easy or even possible to identify these pertinent growth factors, and the only satisfactory procedure for obtaining exact knowledge of their relative significance is to measure them as precisely as possible at periodic intervals throughout several seasonal cycles.

Conditions in Cultivations.

The conversion of established forest lands into commercial crop cultivations is a process often very lightly entered upon by the would-be agriculturist. The axe and the cutlass are two of the most destructive implements ever devised by the hand of man. Within a few hours their indiscriminate application may undo nature's work of centuries. Clear-felling and ruthless burning rapidly interrupt the cycle of changes that has established the equilibrated conditions occurring in natural forest areas. Soon the rich accumulation of organic matter, fixing mineral nutrients and nitrogen, disappears by erosion ; the exhausted " dead " layer of barren soil is bared and exposed, and it is this unpromising medium that the agriculturist has usually to cultivate and to improve if he would confer permanent fertility on his new legacy of soil.

Fortunately, a true appreciation of nature's own methods provides alternative means. The scientific agriculturist, conversant with the ways of nature, concentrates his endeavours on the conservation of the all-important shallow surface layer. He prevents the access of devastating rain, wind and sun, by maintaining as much of the original forest growth as possible through the perpetuation of "shelter woods". He reduces surface water run-off on sloping ground by establishing a suitable cover of vegetation, and by digging contour catchment drains. He initiates another cycle of changes by immediately planting shade trees and his own particular tree crop, even before the original forest growths have been removed. If he is skilful in all these matters, no serious interruption of nature's cycle need necessarily occur, and the resources of the rich surface soil are successfully diverted to the nutrition of the new crop without loss.

The more productive cacao cultivations in Trinidad have been evolved by strict observance of these particulars. Their productivity may usually therefore be readily assessed by measurements of the growth factors presented by the surface soil layer, although this simple procedure may not always be sufficient or precise enough to furnish a complete and exact diagnosis of the soil conditions and of the degree of permanence of fertility. The procedure may partially fail where subsoil conditions play an important rôle in the growth of the crop, or where the new crop possesses widely different requirements from the aboriginal forest trees. Lacking suitable methods for rapid subsoil examination, previous experience of cause and effect would appear to be the only, if somewhat drastic and expensive, means of investigation. Fortunately in a sense, such means are available in Trinidad and in other similar countries whose agriculture is emerging from a phase of land exploitation to one of scientific agriculture.

The detailed study of failures may be just as instructive as the study of successful cases where forest has been converted into remunerative crop cultivations. It is from these various points of view that intensive soil investigations in Trinidad hold out much hope for the future progress of its agricultural policies. To this end, every endeavour should be made at this juncture towards the acquisition of as much exact information as possible concerning the relationships between the diverse crops and soils that are so widely represented within the Island.

RÔLE OF POTASSIUM IN TOBACCO.

In a recent paper published in *Industrial and Engineering Chemistry*, Oct. 1936, 28, 10, pp. 1214-1223, Messrs. F. R. Darkis, L. F. Dixon, F. A. Wolf and P. M. Gross, of Duke University, North Carolina, describe the results of their extensive investigations into the relationship between chemical composition of tobacco leaf and the position of the leaf on the stem, in its bearing on the quality-grading of flue-cured tobacco. For any given type, strain or variety of tobacco, it is well known that quality depends mainly on the kind of soil, the sorts of manures used, and the weather during the growing period. In these investigations, the Durham type of tobacco was selected for study; it was grown on a certain suitable soil-type, with the addition of properly balanced manurial mixtures. The harvested crops over a period of four years were flue-cured graded, and prepared for chemical analysis.

The following relationships were established:—

(1) Lowest nicotine content and highest potash content were found in the lowermost leaves and *vice versa* for the upper leaves.

(2) Nicotine content and degree of acidity (hydrogen-ion concentration) were positively correlated.

(3) The content of total acid was directly related to the contents of soluble ash and of total sugars.

(4) The content of total sugars was inversely correlated with amino-acid nitrogen.

(5) The greater the available supply of moisture to the plant during growth and maturation (wet years) the greater the assimilation of potash, and the smaller the amount of nicotine produced; conversely, the smaller the water supply (dry years), the smaller the amount of potash taken up into the leaves, and the greater the quantity of nicotine produced.

These striking relationships demonstrate that potassium exerts a dominating influence on the chemical reactions occurring within the tobacco plant. Apparently, available moisture regulates the assimilation of potash, whilst the plant's need to conserve moisture partly determines the utilisation of potash by the plant. *Under dry growing conditions*, the elaboration of carbohydrates is diminished by a deficiency of potash caused by lack of available water which decreases potash assimilation. Consequently, an increased amount of potash is utilised in the transportation of fatty substances that form protective coatings over the leaf surfaces. These two dry weather effects are accompanied by an increase in the amount of acids formed by the enhanced oxidation of carbohydrates, and by a lowering of pH value. Such conditions favour the formation of stable nicotine salts of organic acids, and therefore reduce the loss of nicotine by volatilisation. Furthermore, the greater development of protective fatty cuticle, as a result of dry weather, also restricts the loss of free nicotine. Both these effects operate to raise the nicotine content of tobacco leaf grown under dry conditions.

The above physiological explanation of the origin of the changes in nicotine content and its relationship to potash content also accounts for the variations found in the nicotine content of leaves occupying different positions on the stem of the tobacco plant.

F. H.

OBITUARY.

Professor Briton-Jones.

With deepest sorrow we have to record the death on 3rd November, of Prof. H. R. Briton-Jones, D.Sc., Ph.D., D.I.C., A.R.C.S., Professor of Mycology and Bacteriology and Dean of the Imperial College of Tropical Agriculture.

Born in South Wales in 1893, Harry Richard Briton-Jones was educated at Llandovery College, and in 1913 went up to the Imperial College of Science and Technology to study botany under Professor (now Sir John) Farmer. His studies were interrupted by four years of active service as a Lieutenant in the Special Reserve of Heavy Artillery, during which he was twice wounded. Returning to South Kensington in 1919 he took the Associateship of the Royal College of Science and the B.Sc. degree of London University, and at the end of the year was appointed Mycologist to the Egyptian Government.

Three years in Egypt were spent in work on the diseases of a wide range of crops. These formed at that time practically a new and unexplored field in mycology, and both in the investigational work itself and in the training of Egyptian staff for technical duties, Briton-Jones showed from the first his great abilities.

Leaving the Egyptian service at the end of 1922 he spent the next three years as Research Mycologist at the Agricultural and Horticultural Research Station of the University of Bristol, at Long Ashton. A series of papers on diseases of various English fruits shows the further development of the practical outlook which was to place him in the front rank of the plant pathologists of the Empire. Their scientific quality earned him in 1926 the degree of Doctor of Science in the University of London.

Thus, on succeeding Professor S. F. Ashby in April 1926, Briton-Jones came to Trinidad with experience both of sub-tropical agriculture and of temperate horticulture that he was to find invaluable in the new problems confronting him in the West Indies. The record of his ten years here amply fulfils the promise with which they opened, and the list of his chief publications shows how great were the services he rendered. The major diseases of sugar-cane, limes, coconuts, coffee, cacao and grapefruit all in turn engaged his attention as well as pathological problems of a more general nature and many minor diseases. To each he brought original contributions of thought and discovery, and practical suggestions for control.

Of proven scientific ability as a mycologist, Briton-Jones preferred the description of plant pathologist, and never lost sight of the economic significance of plant disease. His first thought was for the agriculturist's losses and that fact together with his training and interest in plant physiology coloured all his writing. It explained, among much else, the immense amount of work that he did on Coconut Wilt, long after he was convinced that no parasite was concerned. It explained also his impatience with the limitations of mycology in the narrower sense. The study of a fungus, or even the control of a disease, was always to him but a means to an end, and the end was more profitable crop production. His textbook, "The Diseases and Curing of Cacao" published in 1934 expresses his outlook on almost every page.

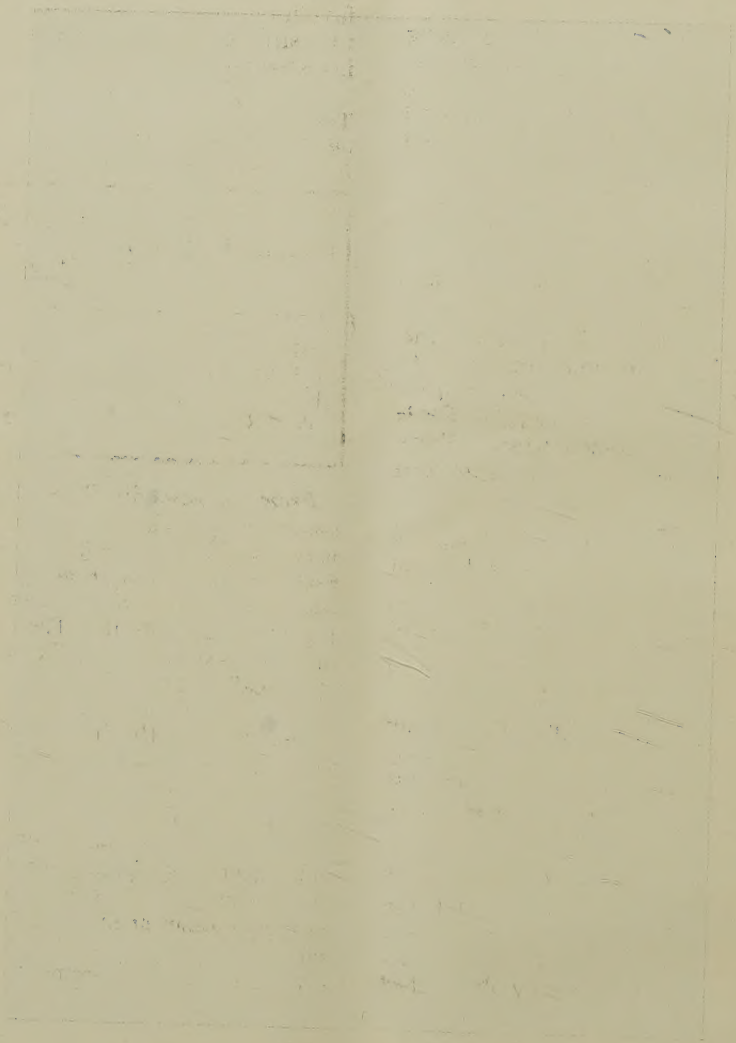
In 1934, when the new Plant Quarantine Station for the West Indies was opened, Briton-Jones was appointed the first Secretary and Chief Executive Officer. To this post he brought the same conscientious endeavour that he devoted to research.

With his breadth of outlook and experience he could not fail to be a stimulating teacher, and into his lectures and field demonstrations he put his best. It is consolation to remember that through them his influence lives on throughout the Colonial Agricultural Service.

His work as Professor of Mycology, however, was only part, and possibly not the greater part, of Briton-Jones's service to the Imperial College of Tropical Agriculture. When in 1927 the office of Dean was instituted he was the obvious man to fill it, and he held it to the day of his death. The duties of the Dean are various, and on his interpretation they stopped short of nothing that could contribute to the welfare, comfort and happiness of the students. Himself in earlier days a fine runner and Rugger player, with interests in many other forms of sport, it was his delight to encourage and assist in every way possible the games and social activities of the community. On the more serious side, when matters of discipline had to be dealt with, he was no less qualified to admonish or advise. Combining to a rare degree a knowledge of the world and its ways with an evergreen idealism, he was never the aloof mentor, but always fellow man. His judgment of a character was very rarely at fault, and his quick sympathy would pick out the best in it and appeal to that, without clouding in the least his perception of weaknesses needing correction.

The qualities that made a good Dean made a lovable colleague, and staff and students past and present, will be at one in their grateful memory of him as a man. We deplore the loss to the College and to tropical agriculture generally of an officer of great achievements and still greater promise. We mourn personally and intimately the loss of "B-J.", the wise and sympathetic counsellor, the generous and loyal friend.

The late Dr. H. R. BRITON-JONES, D.Sc., Ph.D., D.I.C., A.R.C.S.



RECENT INVESTIGATIONS ON SUGAR-CANE AND SUGAR-CANE SOILS IN TRINIDAD.

III.—Effects of Manurial Treatment with Ground Limestone on Crop Quality and Yield of Commercial Sugar.—*Continued.*

By P. E. Turner,
Sugar Agronomist to the Department of Agriculture, Trinidad.

Effect of Size of Dressing of Lime on Dissolved Solids in Juice (°Brix).

Plant Canes.

Measurements of the effect of size of dressing of limestone, under conditions very favourable, favourable and unfavourable to ripening, on the amount of dissolved solids in the juice expressed from the plant canes of Experiments V, IV and XIV are summarised in Table VI.

Conditions Very Favourable to Ripening.

B.156, plant canes, 20 months old.

The °Brix is 17.78 for the plant canes of variety B.156 on the unlimed plots. The value rises to 17.85 and 17.87 on the plots limed to half the lime requirement and to the lime requirement, respectively. At one-and-a-half the lime requirement there is a fall to 17.62, an amount which is smaller than that for the unlimed plots. These values are means for both unpenmanured and penmanured plots.

If the relationship between °Brix and size of dressing of limestone is represented by an equation of the type $Y=A+B\xi_1+C\xi_2$, the constants A, B, C and B/2C have the values

$A=+17.78$. $B=-0.046\pm0.0055$.
$C=-0.080\pm0.006$ $B/2C=0.288\pm0.033$.

The values for B, C and B/2C are statistically significant. *Consequently the rise and fall, which occurs in °Brix as the manurial treatment with lime increases, may be accepted with a reasonable degree of certainty.*

Values for °Brix calculated by use of the formula $Y=A+B\xi_1+C\xi_2$ are set out in Table VII. The calculated values are in near agreement with the observed values. The °Brix-limestone curve, which is graphically illustrated in Figure III, therefore approximates closely to parabolic form. It will be recollected that sucrose-limestone curve obtained under conditions very favourable to ripening also approximates closely to parabolic form (Figure I) over the range investigated.

Table VII.—*Effect of size of dressing of limestone on °Brix under moisture conditions very favourable to ripening. Plant canes of variety B.156.*

Dressing of Limestone.	Value for °Brix.	
	Observed.	Calculated.
Nil	17.78	17.77
½ L.R.	17.85	17.88
L.R.	17.87	17.84
1½ L.R.	17.62	17.63

From the value for B/2C it can be shown that the amount of dissolved solids in the juice attains its maximum at a dressing of limestone equal to 0.61 *times the lime requirement of the soil.* Maximum sucrose in juice was found to occur at 0.52 times the lime requirement. The difference in position of the maxima for °Brix and sucrose is not statistically significant.

The °Brix of the juice of the plant canes from the unpenmanured plots is 17.90 and from the penmanured plots is 17.65. The existence of an interaction between pen manure and the position of the maximum point on the °Brix-limestone curve (such as obtains for the sucrose-limestone curve) cannot be statistically established, possibly because measurement of the amount of dissolved solids in juice does not approach as high a degree of accuracy as measurement of amount of sucrose.

Table VI.—*Effect of size of dressing of limestone on amount of dissolved solids in juice of plant cane.*

(Amount of solids is expressed as °Brix)

Experiment.	Variety of cane.	Age of plants at sampling.	Manurial treatment with limestone.				Conditions for ripening.
			Nil	½ L.R.	L.R.	1½ L.R.	
V	B.156	20 months	17.78	17.85	17.87	17.62	Very favourable.
IV	B.H.10 (12)	18 months	23.45	23.34	23.35	23.23	Favourable.
XIV	B.H.10(12)	17½ months	17.38	16.81	—	—	Unfavourable.

Conditions Favourable to Ripening.

*B.H.*10(12), *plant canes, 18 months old.*

The °Brix of the juice expressed from the cane on the unlimed plots is 23.45. The sequence of values for the limed plots is 23.34, 23.35 and 23.23. The average value for the limed plots is 23.31. These data suggest that manurial treatment with limestone caused a small depression in the amount of dissolved solids in the juice. The depression lies within the range of experimental error, however.

The °Brix-limestone curve is recorded in Figure IV.

Conditions Unfavourable to Ripening.

*B.H.*10(12), *plant canes, 17½ months old.*

The °Brix of the juice from the cane on the unlimed plots is 17.38. The value for the plots dressed with lime before ploughing is 16.94. That for the plots limed after ploughing is 16.68. The effect of time of application of the dressing cannot be established as statistically significant, but *the average depression in °Brix of* 0.57 *resulting from liming might be due to chance about once in* 20 *times.*

RATOON CANES.

Conditions Unfavourable to Ripening.

Measurements of the effect of dressings of ground limestone on °Brix of the juice of the ratoon canes, conditions being unfavourable to ripening, are summarised in Table VIII.

*B.*156, *first ratoon, 13 months old.*

The °Brix for the ratoon cane on the unlimed plots is 19.66. The average value for the limed plots is 19.56. The apparent depression in °Brix due to liming lies within the range of experimental error.

B.H. 10(12), *first ratoon, 13 months old.*

The °Brix for the ratoon cane on the unlimed plots of Experiment IV is 22.33. The values for the limed plots, in order of size of dressing of limestone, are 22.04, 22.08, and 21.92. *The average depression of* 0.32 *lb. of dissolved solids per* 100 *lbs. of juice, resulting from liming, might be due to chance less than once in* 100 *times.* The magnitude of the depression appears to be independent of the size of dressing of limestone.

The °Brix-limestone curves for the ratoon canes 13 months old, of variety B.156 and B.H.10(12), are graphically represented in Figure IV.

*B.H.*10(12), *first ratoon, 12 months old.*

The dressing of limestone equal to the lime requirement led to a fall in °Brix from 19.90 to 19.70 in Experiment XV.

The trend of the effects of manurial treatment with ground limestone on the amount of dissolved solids in juice lies in the same direction for the one experiment on plant canes and the three experiments on ratoon canes which were sampled after periods of comparatively heavy rainfall. *There seems to be little doubt that dressings of ground limestone can cause a depression in °Brix when moisture conditions are unfavourable to ripening.*

TABLE VIII.—*Effect of size of dressing of limestone on amount of dissolved solids in juice of ratoon cane.*

(AMOUNT OF SOLIDS IS EXPRESSED AS °BRIX.)

Experiment.	Variety of cane.	Age of ratoon at sampling.	Manurial treatment with limestone.				Conditions for ripening.
			Nil	½ L.R.	L.R.	1½ L.R.	
V	B.156	13 months	19.66	19.58	19.59	19.50	Unfavourable.
IV	B.H. 10 (12)	13 months	22.33	22.04	22.08	21.92	Unfavourable.
XV	B.H. 10 (12)	12 months	19.90	—	19.70	—	Unfavourable.

TABLE IX.—*Effect of size of dressing of limestone on the purity of juice of plant cane.*

Experiment.	Variety of cane.	Age of plants at sampling.	Manurial treatment with limestone.				Conditions for ripening.
			Nil	½ L.R.	L.R.	1½ L.R.	
V	B.156	20 months	87.0	87.4	86.5	86.5	Very favourable.
IV	B.H. 10 (12)	18 months	91.0	90.8	90.9	91.0	Favourable.
XIV	B.H. 10 (12)	17½ months	86.0	83.9	—	—	Unfavourable.

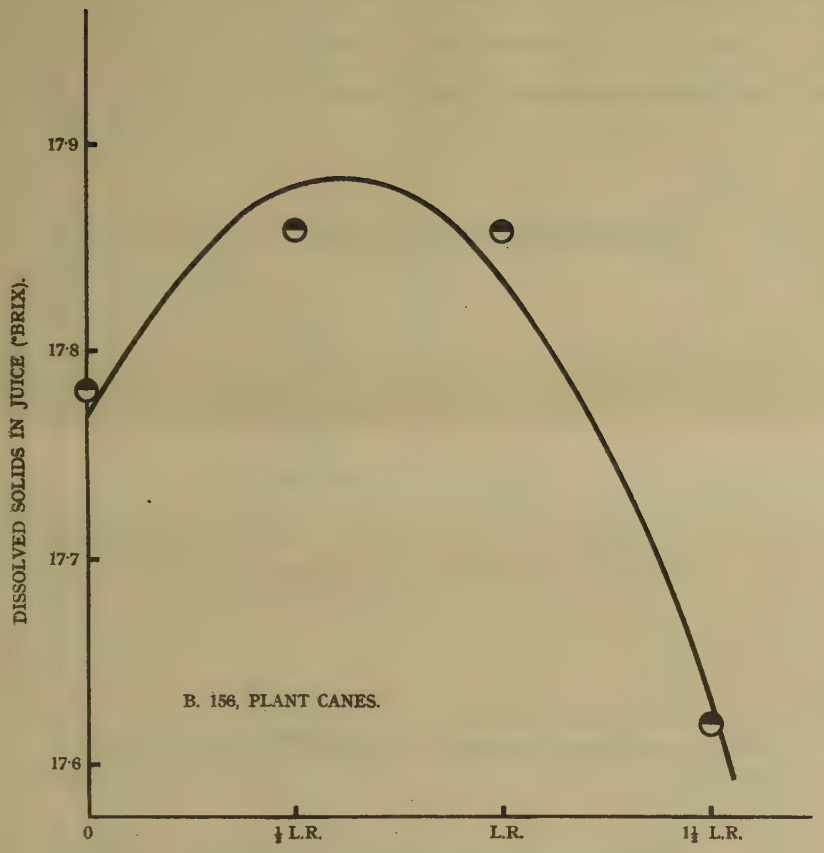


FIG. III.—EFFECT OF INCREASING MANURIAL TREATMENT WITH GROUND LIMESTONE ON °BRIX OF JUICE UNDER MOISTURE CONDITIONS VERY FAVOURABLE TO RIPENING.

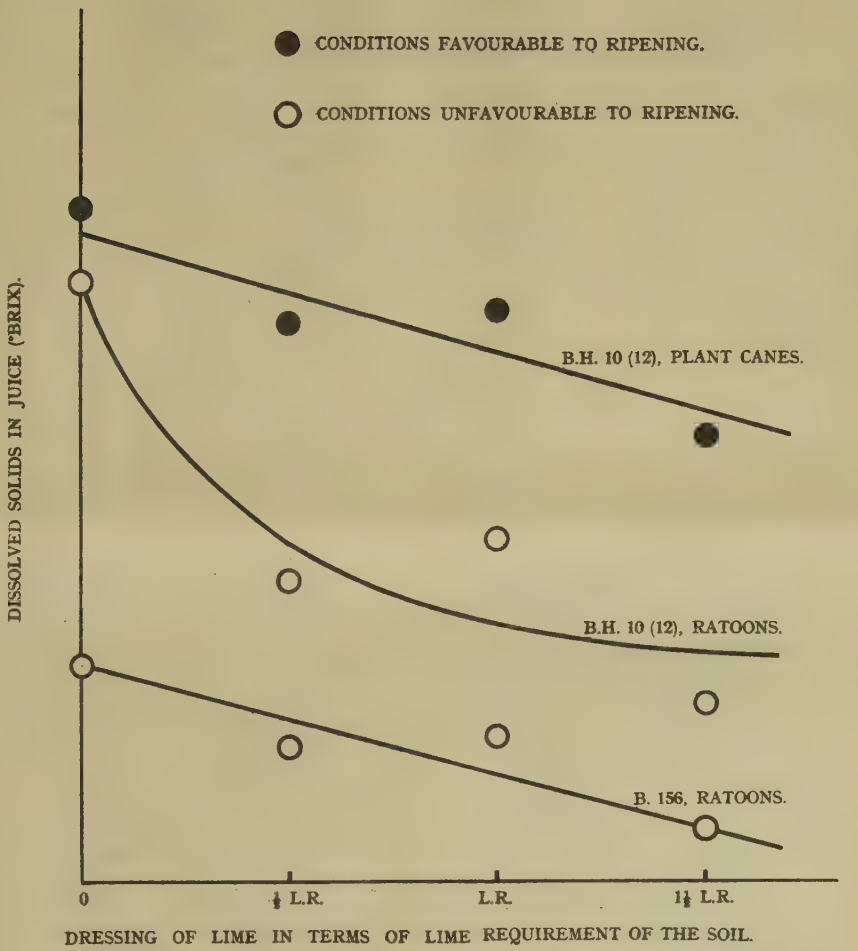


FIG. IV.—EFFECT OF INCREASING MANURIAL TREATMENT WITH GROUND LIMESTONE ON °BRIX OF JUICE UNDER MOISTURE CONDITIONS FAVOURABLE AND UNFAVOURABLE TO RIPENING.

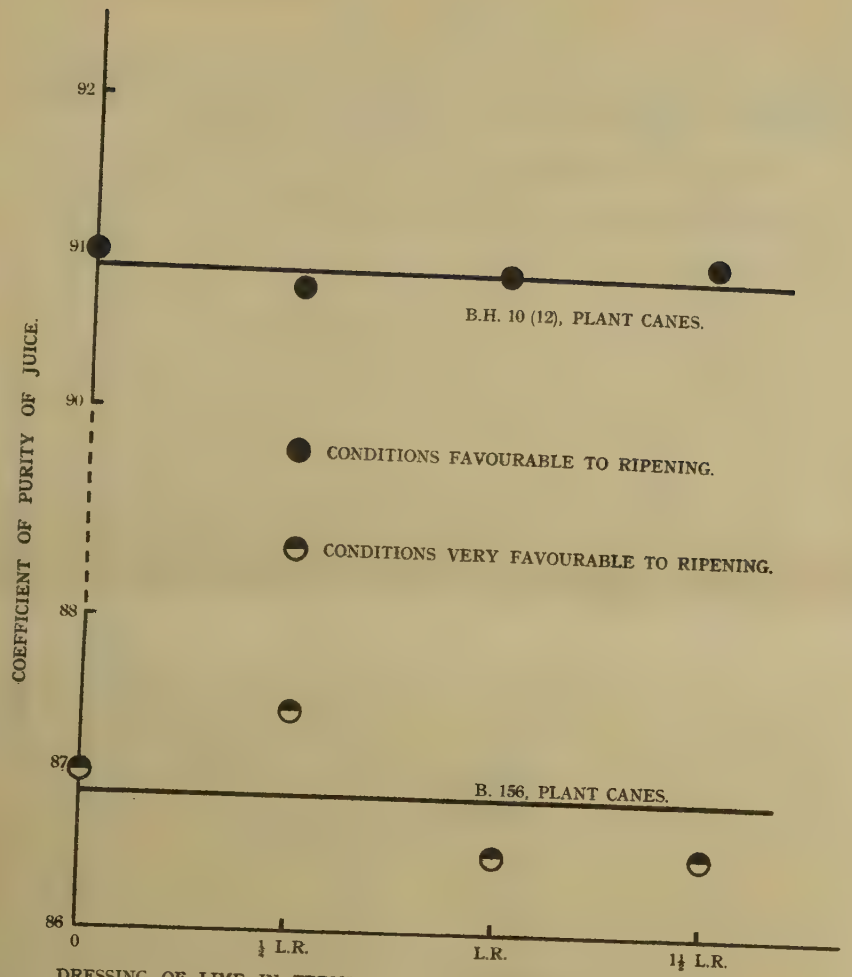


FIG. V.—EFFECT OF INCREASING MANURIAL TREATMENT WITH GROUND LIMESTONE ON THE COEFFICIENT OF PURITY OF JUICE UNDER CONDITIONS VERY FAVOURABLE AND FAVOURABLE TO RIPENING. (Purity of juice of the variety B. 156 does not attain as high a value as that of B.H. 10 (12)).

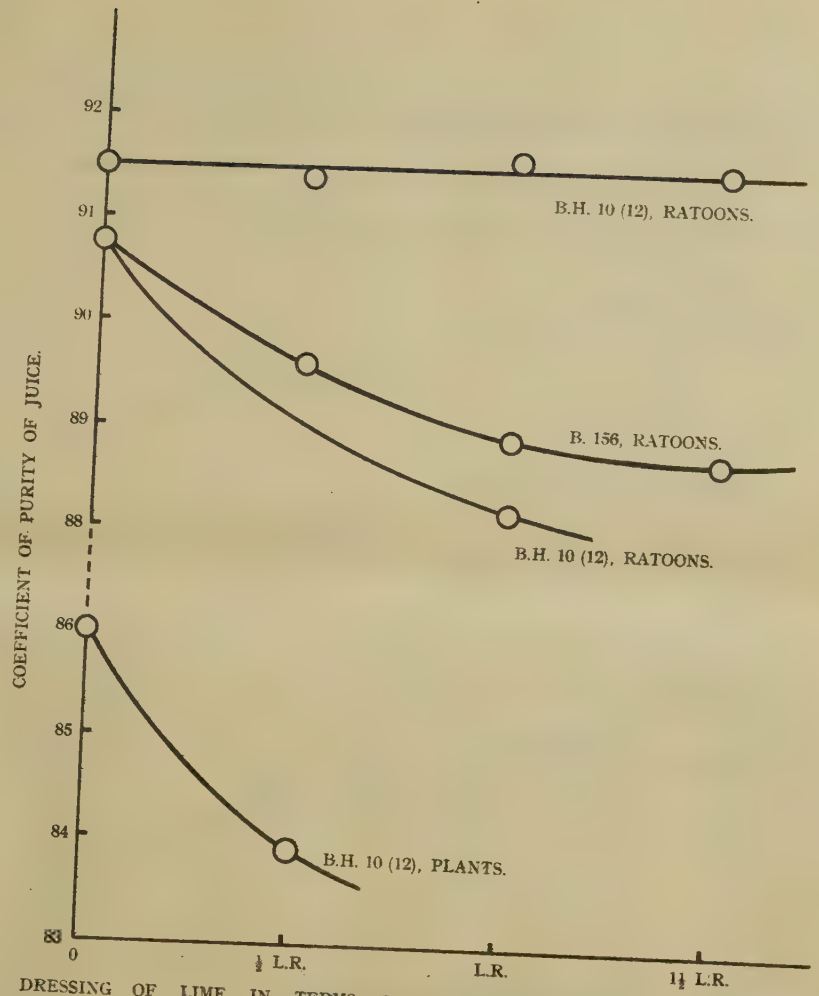


FIG. VI.—EFFECT OF INCREASING MANURIAL TREATMENT WITH GROUND LIMESTONE ON THE COEFFICIENT OF PURITY OF JUICE UNDER CONDITIONS UNFAVOURABLE TO RIPENING.

Effect of Size of Dressing of Lime on Purity of Juice.

The coefficient of purity represents the amount of sucrose in juice as a ratio of the amount of dissolved solids. The coefficient is derived from the formula :—

$$\text{Purity} = \frac{\text{Per cent. sucrose in juice}}{\text{°Brix}} \times 100$$

PLANT CANES.

Data are set out in Table IX which give a measure of the effects of size of dressing of limestone on the purity of the juice expressed from plant canes under the range of ripening conditions.

Conditions Very Favourable to Ripening.

B.156, plant canes, 20 months old.

Manurial treatment with limestone had no well-defined effect on the purity of the juice of the plant canes of variety B.156. The coefficient for the unlimed plots is 87.0. The sequence of values for the limed plots is 87.4, 86.5 and 86.5. It would appear that any effect which the rise and subsequent fall in the sucrose content of the juice, due to increasing manurial treatment with limestone, might have on the purity of the juice is largely counteracted by the corresponding rise and fall in °Brix.

The purity-limestone curve is recorded in Figure V.

Conditions Favourable to Ripening.

B.H.10(12), plant canes, 18 months old.

The dressings of limestone caused little change in the amount of sucrose and total dissolved solids in the juice of the plant canes. Consequently the coefficient of purity of the juice remains appreciably unchanged. The average values of the coefficient for the unlimed and limed plots are 91.0 and 90.9, respectively.

The purity-limestone curve is illustrated in Figure VI.

Conditions Unfavourable to Ripening.

B.H.10(12), plant canes, 17½ months old.

The purity of the juice of the plant canes fell from the value 86.02 on the unlimed plots to 84.23 on the plots limed to half the requirement of the soil before ploughing, and to 83.66 on the plots limed to half the requirement after ploughing. The effect on the coefficient of purity of time of application of the lime is not statistically significant, but *the average depression in the coefficient, resulting from liming, might be due to chance less than once in 20 times.*

In this experiment manurial treatment with limestone led to a depression in the amount of sucrose and in the amount of dissolved solids in the juice. The effect of the dressing on sucrose content is proportionately greater than its effect on the total dissolved solids.

RATOON CANES.

Conditions Unfavourable to Ripening.

Data for the relationship between size of dressing of limestone and purity of the juice expressed from ratoon canes, under conditions unfavourable to ripening, are recorded in Table X.

B.156, first ratoon, 13 months old.

Manurial treatment with limestone led to a fall in the sucrose content of the juice of the ratoon canes of variety B.156, but had little or no effect on the concentration of dissolved solids. Consequently the treatment had an adverse influence on the purity of the juice. The coefficient for the limed plots is 90.7. As the dressing of lime increases the coefficient continues to decrease, the sequence of values being 89.6, 88.9 and 88.7. The fall in purity might be due to chance less than once in 20 times. It obtained both for the canes on the unpenmanured and the penmanured plots (Table XI).

TABLE XI.—*Effect of size of dressing of limestone on purity of juice under conditions unfavourable to ripening. B.156, first ratoons.*

Dressing of limestone	N 1	½ L.R.	L.R.	1½ L.R.
Unpenmanured plots	90.4	90.3	89.3	89.3
Penmanured plots	91.0	88.9	88.5	88.1
Average value ..	90.7	89.6	88.9	88.7

TABLE X.—*Effect of size of dressing of limestone on the purity of juice of ratoon cane.*

Experiment.	Variety of cane.	Age of ratoon at sampling.	Manurial treatment with limestone.				Conditions for ripening.
			Nil	½ L.R.	L.R.	1½ L.R.	
V	B.156	13 months	90.7	89.6	88.9	88.7	Unfavourable.
IV	B.H. 10 (12)	13 months	91.5	91.4	91.6	91.5	Unfavourable.
XV	B.H. 10 (12)	12 months	90.8	—	88.2	—	Unfavourable.

*B.H.*10(12), *first ratoon, 13 months old.*

In Experiment IV dressing with limestone caused a depression in the amount of sucro e and in the amount of dissolved solids in the juice of the ratoon canes of variety B.H.10(12). Under the conditions controlling the experiment the effect of this treatment on sucrose content is proportionately equal to its effect on amount of the other dissolved solids, for the coe ficient of purity of the juice remains unchanged. The coefficient is 91.5 for the unlimed plots. The average value for the limed plots also is 91.5.

The purity-limestone curves for the ratoon canes, 13 months old, of variety B.156 and B.H.10(12), are graphically represented in Figure VI.

B.H. 10(12), *first ratoon, 12½ months old.*

The trend of the results for the ratoon canes of Experiment XV is similar to that recorded for the plant canes of Experiment XIV. Liming led to a depression in the amount of sucrose in juice and in °Brix. As the depression in sucrose content is propo tionately the greater, a fall in purity obtains. The values of the coefficient for the unlimed and limed plots are 90.8 and 88.2 respectively.

In three of the four experiments, which were sampled under moisture conditions unfavourable to ripening, manurial treatment with ground limestone resulted in a depression in the coefficient of purity of th juice. In the fourth experiment there was no measurable change in the coefficient. It is of interest that no example of an improvement in juice purity, consequent upon liming, has so far been recorded in Trinidad.

Results obtained elsewhere.

Williams and Follett Smith (2) in British Guiana found dressings of lime to lead to a significant improvement in purity of juice in one experiment, a significant depression in another experiment and to have no effect in two other experiments. Rodriguez (8) in Trinidad, and Pritchett (9) in the Philippines, record reductions in juice purity due to liming.

Effects of Manurial Treatment with Lime on Crop Quality.

SUMMARY.

The effects of increasing manurial treatment with ground limestone on crop quality under the range of conditions which obtained in Experiments IV, V, XIV and XV are summari ed in Table XII.

Conditions Very Favourable to Rip ning.

*B.*156, *plant canes, 20 months old.*

The soil of the experimental area approximates to a loam. Rainfall was very light during the two months before sampling. The plant canes had an over-ripe appearance, and there was an average loss in yield, due to drying out, of at least five tons of cane to the acre.

A small dressing of limestone led to an increase in the amount of sucrose in cane (pol. per cent. cane). Heavier dressings caused the sucrose content to fall. On the plots treated with one-and-a-half the lime requirement the amount of sucrose in cane was smaller than on the unlimed plots. The maximum value for sucrose, in terms of the lime requirement, was found to be dependent on the basal manurial treatment. In the presence of a dressing to he acre of 20 tons of pen manure maximum sucrose occurred at 0.39 times the lime requirement. In the absence of pen manure the maximum value corresponded to 0.67 times the lime requirement. The maximum value for all plots, irrespective of treatment with pen manure, was found to lie at 0.58 times the lime requirement.

Increasing dressings of limestone were found to have a parallel sequence of effects on the amount of sucrose in the juice expressed from the plant canes. Maximum values for sucrose in juice, in the presence and absence of basal pen manure, correspond respectively to 0.28 times and 0.64 times the lime requirement. The maximum value for all plots occurs at 0.52 times the lime requirement.

TABLE XII.—*Summary of effects of increasing dressings of ground limestone on crop quality.*

(EFFECTS WHICH CAN BE ESTABLISHED AS STATISTICALLY SIGNIFICANT ARE PRINTED IN ITALICS.)

Experiment.	Variety of cane.	Stage in crop series.	Analysis of cane Sucrose %	Analysis of juice.			Conditions for ripening.
				Sucrose %	°Brix.	Purity.	
V	B. 156	Plants	*Rise & fall*	*Rise & fall*	*Rise & fall*	Nil	Very favourable.
IV	B.H. 10 (12)	Plants	Nil	Nil	Small depression	Nil	Favourable.
XIV	B.H. 10 (12)	Plants	Depression	*Depression*	*Depression*	*Depression*	Unfavourable.
V	B 156	1st R.	Depression	Depression	Small depression	*Depression*	Unfavourable.
IV	B.H. 10 (12)	1st R.	*Depression*	*Depression*	*Depression*	Nil	Unfavourable.
XV	B.H. 10 (12)	1st R.	—	Depression	Depression	Depression	Unfavourable.

A rise and subsequent fall in the amount of dissolved solids in the juice was also found to result from increasing dressings of limestone, the °Brix being larger on the lightly limed than on the unlimed and heavily limed plots. The maximum value (all plots) for °Brix lay at 0.61 times the lime requirement. No definite effect of treatment with pen manure on the position of the maximum value for °Brix could be established.

Increasing dressings of limestone had no well-defined influence on the purity of the juice. Any appreciable effect on the coefficient of purity of the rise and subsequent fall in amount of sucrose in the juice was counteracted by a parallel rise and fall in °Brix.

Conditions Favourable to Ripening.

B.H. 10 (12), *plant canes,* 18 *months old.*

The soil of the experimental area is much heavier in texture than that of the previous experiment. Rainfall was light during the two months before sampling. The canes were mature in appearance and their juice was found to be high in quality. There was a little dried-out cane.

Manurial treatment with lime had no definite effect on the amount of sucrose in cane (pol. per cent. cane), on the amount of sucrose in the juice, on the amount of dissolved solids in the juice or on the purity of the juice. No improvement in crop quality therefore resulted from dressings of limestone varying in size from ten tons to 30 tons to the acre, although favourable ripening conditions prevailed.

Conditions Unfavourable to Ripening.

B.H. 10 (12), *plant canes,* 17½ *months old.*

The soil of the experimental area is a silty clay. Rainfall was heavy during the two months before sampling. The canes were green and immature in appearance and the quality of their juice was found to be poor. There was no dried-out cane on the plots.

The dressing of lime led to a depression in the sucrose content of cane (pol. per cent. cane) and in the content of sucrose and dissolved solids of the juice. The depression in the amount of sucrose in the juice was proportionately greater than depression in the amount of dissolved solids, for the dressing of limestone was found to have an adverse effect on purity.

In this experiment the manurial treatment with lime was applied before ploughing to one series of plots and after ploughing to another series. There are indications that the adverse effect of the late dressing on sucrose in cane, on sucrose in juice, on °Brix and on purity were greater than that of the early dressing, but the statistical significance of these indications cannot be established.

*B.*156, *ratoon canes,* 13 *months old.*

The treatments with limestone had a depressing effect on amount of sucrose in cane and sucrose in juice, and on the purity of the juice, but had no well-defined effect on the amount of dissolved solids in juice. The adverse effect on the purity of the juice appears in this particular instance to increase with the size of the dressing.

B.H. 10 (12), *ratoon canes,* 13 *months old.*

Liming the soil led to a depression in the sucrose content of the cane, and in the content of sucrose and of dissolved solids of the juice. The depression in the amount of sucrose in juice is proportionately equal to the depression in the amount of dissolved soilds, for liming had no effect on purity in this experiment.

B.H. 10 (12), *first ratoons,* 12 *months old.*

The dressing of limestone led to a decrease in the amount of sucrose and dissolved solids in the juice and to a fall in the purity of the juice.

Rainfall was heavy during the two months before sampling in the three experiments on ratoon canes.

Discussion.

The recorded data provide information concerning the general trend and nature of the effects of manurial treatment with lime on quality of sugar cane during the later stages of its life period.

Conditions Unfavourable to Ripening.

As long as moisture conditions are unfavourable to ripening, *i.e.*, are favourable to continued and active vegetative growth, applied limestone can adversely affect the quality of the crop, in that it can depress the concentration of sucrose in cane and the concentration of sucrose and other dissolved solids in the juice. The depression in the amount of sucrose in juice may be proportionately greater than that of the other dissolved solids, in which case there is a fall in the coefficient of purity. Within the limits investigated (one-half to one-and-a-half the lime requirement of the soil) the magnitude of the effect of applied limestone appears in general to be independent of the size of the dressing. The nature of the effect may be explained on the assumption that applied lime continues to be available to the plant, and aids in promoting vegetative growth late in its life, as long as moisture remains adequate. In consequence there is a delay in maturity. It will be shown in a later series of papers that dressings of organic manures can cause a similar delay in maturity through liberation of nutrients late in the life of the plant, and that late dressings of inorganic manures may also have the same effect.

Conditions Favourable to Ripening.

When moisture conditions become favourable to ripening, rather than to active vegetative growth, the effect of applied limestone ceases to

be measurable. It follows that the initial adverse effect of lime on the quality of the crop has been overcome by this stage. During the interval the increase in the ratio of sucrose to other dissolved solids, which is characteristic of the early stages of ripening of sugar-cane, must have taken place at a greater rate on the limed soil than on the unlimed soil. The nature of the effect of the applied lime during this period may be explained, at least in part, on the assumption that the dressing has facilitated loss of soil moisture (by drainage, &c.) through improvement in soil tilth thereby rendering conditions even more favourable to ripening. Size of dressing of limestone still appears to be unimportant within the limits one-half to one-and-a-half the lime requirement of the soil.

Conditions Very Favourable to Ripening.

When moisture conditions have become so favourable to ripening that vegetative growth is on the wane, and the cane begins to dry out, size of dressing of lime becomes of importance. Concentration of sucrose can then attain a higher value on soil treated with an intermediate dressing than on unlimed soil *i.e.* the effect of applied lime on this contributory factor to crop quality now becomes definitely beneficial provided that the dressing is moderate in size. Such a dressing was found to have no well-defined effect on the corresponding value for coefficient of purity. An increase in concentration of sucrose, without appreciable change in the ratio of sucrose to other dissolved solids, is characteristic of the later stages of ripening of sugar cane for all soils, irrespective of their lime status. It therefore seems reasonable to assume that the improvement in crop quality which can ultimately result from a moderate dressing of lime is largely due to the continued indirect effect of the dressing on the moisture status of the soil.

On soil dressed with lime in excess of its lime requirement the concentration of sucrose was found to be lower in value than on unlimed soil, *i.e.*, the effect of lime applied in excess can ultimately become definitely adverse to crop quality. The adverse effect is probably due to an unbalance in the uptake of nutrients by the crop caused by a relative superabundance of lime in the soil. It has previously been shown that dressings of lime in excess of the lime requirement of the soil can cause a depression in yield of cane (3). The factors associated with the depression in yield of cane are probably also associated with the depression in the concentration of sucrose in cane. It is noteworthy that juice purity was not found to be affected by overliming.

There exists a possible alternative interpretation of the data obtained under conditions very favourable to ripening. It is conceivable that the canes were over-mature at the time of sampling, and that deterioration takes place more rapidly on unlimed than on moderately limed soil and more rapidly on overlimed than on unlimed soil. No dried-out cane was included in the samples taken for analysis, however. Further, over-ripeness is characterised by inversion of sucrose and a fall in the ratio of sucrose to dissolved solids *i.e.* by a fall in the coefficient of purity of the juice (10). No such fall in the coefficient was found to obtain.

It is of interest that the optimum dressing of lime associated with maximum crop quality should be reduced by the presence of a basal dressing of pen manure, for pen manure is known to reduce the gain in yield which can result from liming (3). An upset in the uptake of nutrients is probably a factor common to both interactions.

Time of Application of Limestone.

The indications obtained under conditions unfavourable to ripening that the adverse effect of a dressing of limestone may be greater if applied after instead of before ploughing are of importance, for they suggest that the later application of lime is more readily available to the plant. It is possible for such a state of affairs to obtain. The limestone applied before ploughing may be more efficiently mixed with the soil and this should lead to an increase in its rate of chemical action on the soil. More rapid improvement in soil tilth but reduced availability of the lime would result.

(*To be concluded.*)

REFRIGERATION IN AGRICULTURE.

"Refrigeration for the Farm and Dairy" is the title of an illustrated bulletin by C. A. Cameron Brown, published by the Institute for Research in Agricultural Engineering, Oxford (1s. 6d.). The preparation of the bulletin was promoted by the number of inquiries on the subject of milk cooling recently received by the Institute, and it is specially intended for the guidance of farmers, small dairymen and in particular the producer-retailer. After an introductory account of the theoretical side of refrigeration, the compression and absorption systems for obtaining the low temperatures are discussed from the practical point of view, the comparative suitability of the various chemicals that can be used, the type of plant employed and its efficiency all coming under review. The second half of the bulletin deals with the application of refrigeration, chiefly in relation to dairying. A full description is given of the two principal methods for cooling milk, namely, the direct-expansion and the circulation methods. The important question of sterilizing is not overlooked, for the choice of cooling plant may be largely determined by the technique in sterilizing preferred. Cold storage is also considered in detail, the equipment required, its mode and operation being fully described, while figures for running costs are quoted from actual farms. Smaller sections are devoted to the question of portable cooling for the dairyman, and refrigeration on the fruit farm, in the bulb and market gardening industry and in poultry farming.—(*Nature*, Vol. CXXXVIII, No. 3493, p. 649, 1936.)

THE CACAO INDUSTRY OF TRINIDAD.—*Continued.*

SOME ECONOMIC ASPECTS.

Series II.—A Financial Survey of Estates during the seven years 1923-4 to 1929-30.

By C. Y. Shephard.

PART II.—COMPARISON OF THE 'BEST' AND 'WORST' ESTATES.

(*See* Table I and Figs. I-VI).

The estates visited exhibit a wide range in efficiency, some being highly profitable whereas others operated at a loss. These points are illustrated by a comparison and contrast of the 'best' and 'worst' estates. The 'best' estates number one quarter of the total, and consist of those with the lowest costs of production per bag of cacao, while the 'worst' estates are identical in number, but comprise those with the highest costs of production.

Expenditure per Acre (*See* Fig. I).

There is little difference between the total expenditure per acre by the 'best' and 'worst' estates, but considerable variation in the composition of these totals. The 'best' estates spent $18.85 (£3 18*s.* 6½*d.*) per acre on cacao, compared with $20.79 ($4 6*s.* 7½*d.*) on the 'worst' estates, and an average of $20.22 (£4 4*s.* 3*d.*) for all estates*. Thus, the 'best' estates spent $1.37 (5*s.* 8½*d.*) less, and the 'worst' estates 57 cents (2*s.* 4½*d.*) more, per acre than the average.

Expenditure on Cultivation (Items 2 to 9) (*See* Fig. III).

There is a marked difference between the 'best' and 'worst' estates in their expenditure on cultivation. The 'best' estates spent only $5.57 (£1 3*s.* 2½*d.*) per acre, contrasted with $8.97 (£1 17*s.* 4½*d.*) on the 'worst' estates. Thus, the best estates spent $1.68 (7*s.*), or 23 per cent., less than the average, and the 'worst' estates $1.72 (7*s.* 2*d.*), or 24 per cent., more. This contrast is common to each important item of cultivation. For example, on cutlassing and weeding the 'worst' estates spent $4.08 (17*s.*) per acre, and the 'best' estates only $2.49 (10*s.* 4½*d.*) On supplying cacao and shade, the 'worst' expended 97 cents. (4*s.* 0½*d.*), and the 'best' 51 cents (2*s.* 1½*d.*). Similarly, on trimming and pruning the expenditure was $1.99 (8*s.* 3½*d.*) contrasted with $1.44 (6*s.*), and on draining and round-ridging $1.02 (4*s.* 3*d.*) as against 61 cents. (2*s.* 6½*d.*) The contrast persists even in the minute expenditure on manuring. The 'best' estates purchased no manure, and spent an average of only 15 cents (7½*d.*) per acre in applying stable manure. The expenditure per acre on the 'worst' estates averaged 24 cents (1*s.*) for the purchase of manures (item 15), and 55 cents (2*s.* 3½*d.*) on applying manures. There is only one small item in which the usual order was reversed: the 'best' estates spent 23 cents (11½*d.*), and the 'worst' estates 17 cents (8½*d.*), on the control of pests and diseases, compared with an average of 21 cents (10½*d.*) per acre.

The heavier expenditure on cultivation by the 'worst' estates indicates an attempt to overcome unfavourable natural conditions. The 'best' estates suffer fewer tree casualties, the weed growth is less troublesome, the trees respond more readily to pruning, thrips and beetles cause less damage, and satisfactory yields were obtained without recourse to manures. The standard of cultivation on the 'best' estates was, in fact, higher than on the 'worst' estates, despite the smaller expenditure.

Yields (*See* Fig. IV).

The contrast between yields is most striking. The 'best' estates reaped twice the quantity of cacao per acre obtained by the 'worst' estates. Thus, the production of the 'best' estates averaged 7.37 bags of cacao per 1,000 pickets, 2.11 bags or 347 lb. per acre, or 1.22 lb. per picket, contrasted with 3.70 bags per 1,000 pickets, 1.01 bags or 167 lb. per acre, or 0.61 lb. per picket on the 'worst' estates. It may be noted that the expenditure per acre on management and supervision was much the same in both groups of estates, the 'best' spending $4.82 (£1 0*s.* 1*d.*), and the 'worst' $4.63 (19*s.* 3½*d.*), compared with an average of $4.91 (£1 0*s.* 5½*d.*). Moreover, several individuals managed estates included in both groups. The yields of even the best estates fall far short of those claimed in Grenada and West Africa.

Reaping and Manufacture (Items 10 and 11) (*See* Figs. I and II).

The heavier crops of the 'best' estates necessitate a larger outlay per acre on reaping and manufacture than on the 'worst' estates. Thus, the expenditure per acre on the 'best' estates was $3.06 (12*s.* 9*d.*) for reaping, and $1.06 (4*s.* 5*d.*) for manufacturing, compared with $2.03 (8*s.* 5½*d.*) for reaping, and 59 cents (2*s.* 5½*d.*) for manufacturing, on the 'worst' estates. On the other hand the cost of these operations per bag was much less on the 'best' than on the 'worst' estates. Reaping cost $1.45 (6*s.* 0½*d.*) per bag on the 'best' estates, and $2.01 (8*s.* 4½*d.*) on the 'worst' estates, and manufacturing 50 cents (2*s.* 1*d.*), compared with 58 cents (2*s.* 5*d.*). The difference is less in the case of manufacturing because each shed requires its complement of labour, and the number of sheds is proportionate to the size of the crop. An examination of individual estate records shows that the cost per bag of reaping cacao is much higher at the beginning and towards the end of the crop, when pickings are small, than during the height of crop.

Cost of Production (*See* Fig. II).

With the exception of the transport of cacao from the estate to the merchant's store the expenditure per acre on every other item was a little higher on the 'worst' than on the 'best' estates, but, owing to differences in yield, the cost per bag of cacao was much higher on the

* The revenue from intercultivated crops has been subtracted from the total expenditure on cacao. This subtraction is not shown in Figs. I and II.

'worst' than on the 'best' estates. For example, the 'best' estates spent $1.45 (6s. 0½d.) per acre on livestock (including foodstuffs) compared with $1.50 (6s. 3d.) on the 'worst' estates, but the cost per bag of cacao was only 66 cents (2s. 9d.) on the 'best' estates contrasted with $1.49 (6s. 2½d.) on the 'worst' estates. The cost of cultivation amounted to $2.64 (11s.) per bag on the 'best' estates, and $8.85 (£1 16s. 10½d.) on the 'worst' estates. The 'best' estates produced cacao at $9.02 (£1 17s. 7d.) per bag, or less than half the cost of the 'worst' estates, $21.11 (£4 7s. 11½d.). The low yields of cacao on the 'worst' estates encouraged owners to plant other crops between the cacao trees to obtain a subsidiary source of income, and with the intention of removing the cacao if the new crop offered greater prospects of profit. A revenue of 60 cents (2s. 6d.) per acre was obtained from intercultivated crops. The 'best' estates, on the other hand, found cacao profitable, and, in general, allowed no other crop to compete with it. They derived an income of only 14 cents (7d.) per acre from intercultivated crops. The cost of producing cacao, after deducting the revenue from intercultivated crops, amounted to $8.95 (£1 17s. 3½d.) per bag, or $5.97 (£1 4s. 10½d.) per fanega, on the 'best' estates, and $20.51 (£4 5s. 5½d.) per bag, or $13.67 (£2 16s. 11½d.) per fanega, on the 'worst' estates.

Profits and Losses (*See* Figs. V and VI).

Despite the high price of cacao the 'worst' estates incurred a loss of $1.74 (7s. 3d.) per bag, or $1.16 (4s. 10d.) per fanega, which is equivalent to $1.76 (7s. 4d.) per acre. The 'best' estates, however, earned profits of $9.43 (£1 19s. 3½d.) per bag, $6.29 (£1 6s. 2½d.) per fanega, or $19.86 (£4 2s. 9d.) per acre. During 1930-31 to 1935-36 the price of cacao averaged $6.67 (£1 7s. 9½d.) per fanega, or little more than half that obtained during the period under review. The heavy fall in the price of cacao, the appearance of Witchbroom disease, and falling yields have reduced the 'worst' estates to desperate straits. The possibility of earning profits has permanently ceased on most of these estates, and they no longer constitute an asset, but rather a liability, to their owners. The fact that, during 1923-4 to 1929-30, they derived 17 per cent. of their total revenue from sources other than cacao indicates that some doubt was entertained as to their suitability to cacao production. Since 1929-30 attempts to discover profitable alternative crops have been intensified. Yet, at one time, these estates earned large profits from cacao, and the discovery of the causes of their decline in efficiency is a matter of considerable importance and urgency not only to Trinidad but also to every other cacao producing country. The owners of the 'best' estates considered that cacao offered greater prospects of profit than any alternative crop, and relied upon this one source for 98 per cent. of their total revenue.

Mortgages.

The solvency of many estate owners is prejudiced by the burden of heavy mortgages. The 'best' estates are far more heavily encumbered than the 'worst' estates. The 'best' estates paid the equivalent of $3.85 (16s. 0½d.) per acre, or $1.83 (7s. 7½d.) per bag in interest charges, contrasted with only 59 cents (2s. 5½d.) per acre, or 58 cents (2s. 5d.) per bag for the 'worst' estates. The inference that the 'best' estates were enabled to borrow more because they afforded greater security provides a very inadequate explanation of the difference in amount of encumbrance. Most of the mortgages were obtained on young, high-yielding cacao during the 'golden age' of the industry, when every cacao mortgage was regarded as a gilt-edged security. The 'best' estates consist either of cacao too young to have afforded adequate opportunity for the repayment of loans, or older cacao capable of making regular payments of interest. Many of the 'worst' estates were taken over by the mortgagees because the interest fell seriously into arrears and the estates therefore appear as free of encumbrances.

The slow turnover of capital tends to heighten the incidence of interest charges on borrowed capital. The valuation of all the estates visited averaged $238 (£49 11s. 8d.) per acre, and the annual income $29.17 (£6 1s. 6½d.) per acre. A single turnover of the capital would therefore occupy eight years at this rate. The 'best' estates obtained a revenue of $2 for every $1 expended but the profit represented an interest of only eight per cent. on the capital. Some estates changed hands at inflated values immediately after the War, the purchase money being obtained, in part, on mortgage at rates of interest ranging from six to 12 per cent. per annum. The low price of cacao in 1930-31, necessitated an immediate and severe curtailment of expenditure in order to meet interest charges on mortgages, and the continuance of low prices has thrown many estates into serious arrears. It is probable that many estates will change hands.

Summary.

Despite the fact that the 'best' estates spent considerably less per acre than the 'worst' estates on every important item of cultivation they obtained double the yield. The cost of reaping, manufacturing and transporting the heavier crops of the 'best' estates raised their total expenditure per acre to a little less than the 'worst' estates, but the cost of production per bag of cacao on the 'best' estates was less than half that on the 'worst' estates. On the 'best' estates half the total revenue represented profit, but the 'worst' estates operated at a small loss despite the high price of cacao. The low prices obtained for cacao since 1929-30, the spread of Witchbroom disease, and the decline in efficiency due to neglected cultivation have rendered the 'worst' estates liabilities rather that assets. The 'best' estates are more heavily mortgaged than the 'worst' estates, and in many cases interest payments have fallen seriously into arrear.

COMPARISON OF THE BEST, ALL, AND WORST TRINIDAD CACAO ESTATES, 1923-4 TO 1929-30

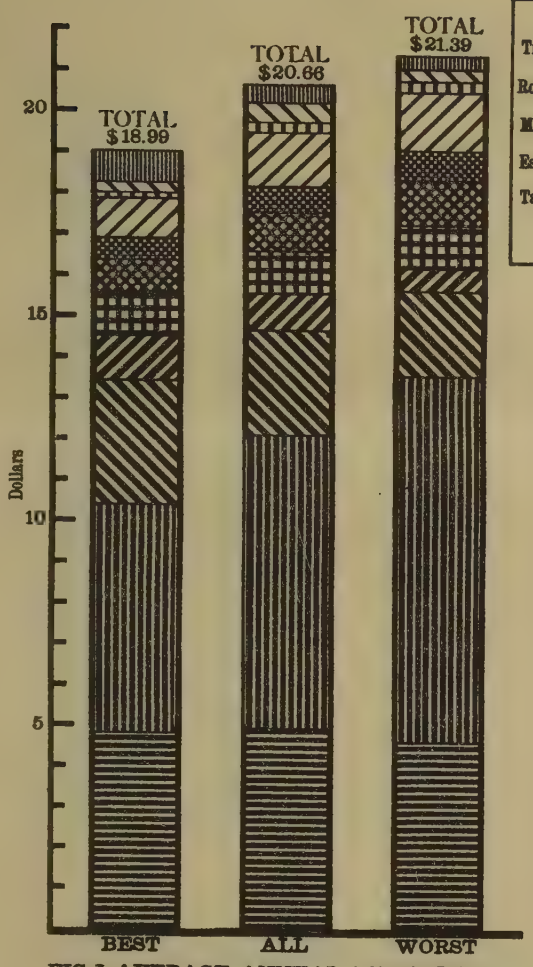


FIG. I. AVERAGE ANNUAL EXPENDITURE PER ACRE

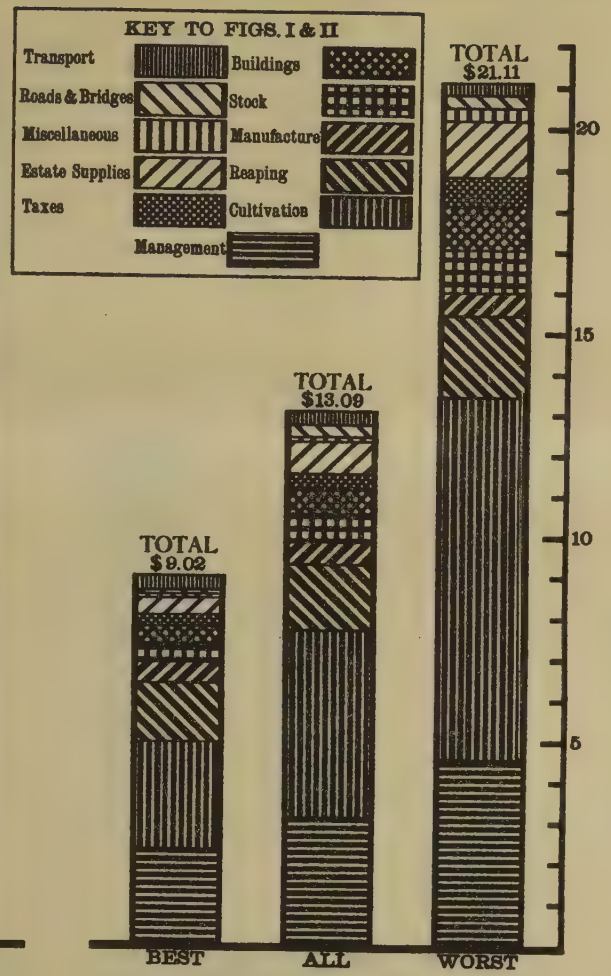


FIG. II. COST OF PRODUCTION PER BAG (165 lb.) OF CACAO

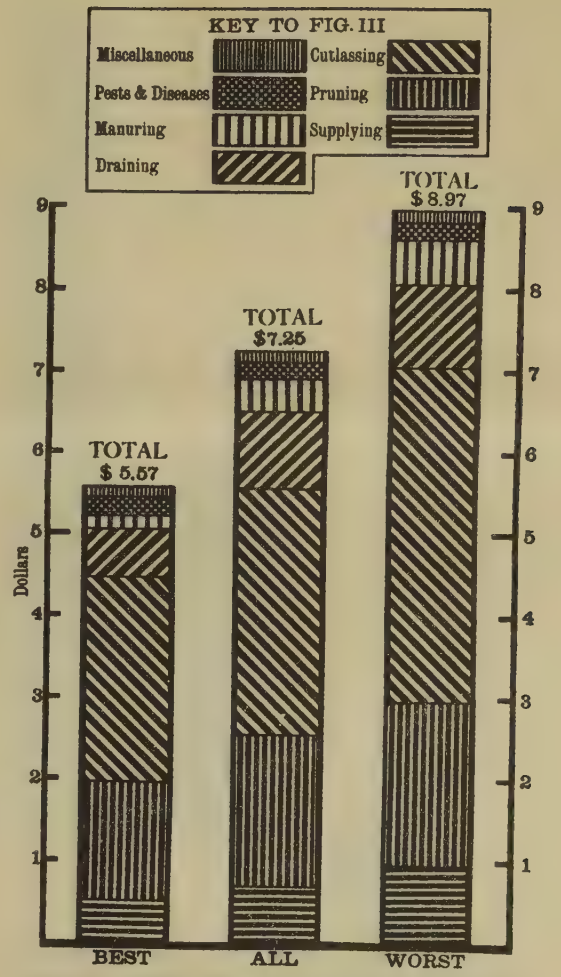


FIG. III. AVERAGE ANNUAL EXPENDITURE PER ACRE ON CULTIVATION

COMPARISON OF THE BEST, ALL, AND WORST TRINIDAD CACAO ESTATES, 1923-4 TO 1929-30

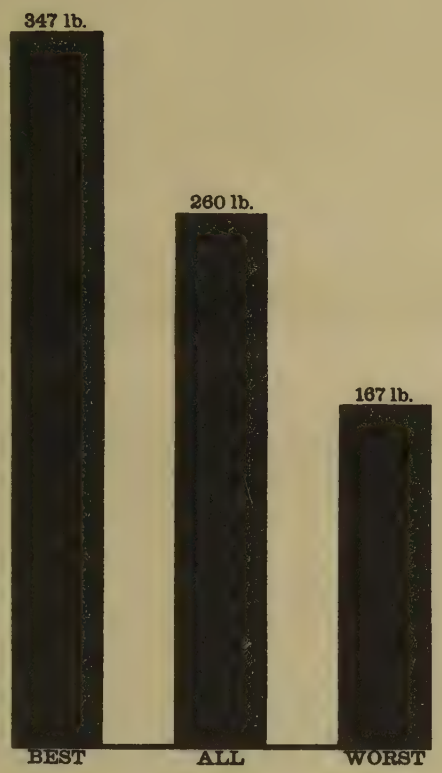


FIG. IV. AVERAGE ANNUAL YIELD PER ACRE

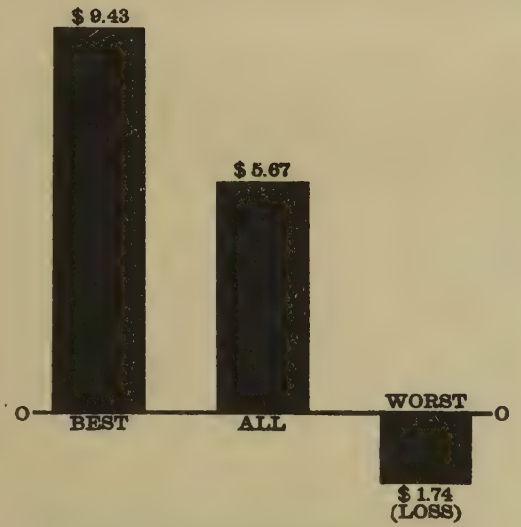


FIG. V. PROFIT OR LOSS PER BAG (165 lb.) OF CACAO

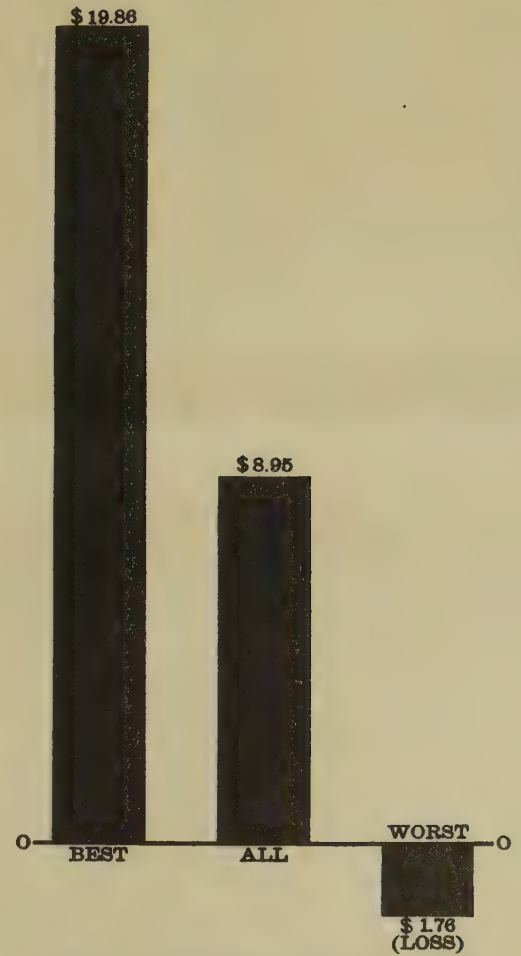


FIG. VI. AVERAGE ANNUAL PROFIT OR LOSS PER ACRE

Table I.—Analysis of the Expenditure, Revenue, &c., of 126 **TRINIDAD CACAO ESTATES** for the Seven financial years 1923-4 to 1929-30.

No.	Item.	Expenditure per Acre of Cacao.			Cost per Bag (165 lb.) of Cacao.			Item No.
		Group of Estates.			Group of Estates.			
	Description.	Best.	All.	Worst.	Best.	All.	Worst.	
		$ c.	$ c.	$ c.	$ c.	$ c.	$ c.	
1	Management and Supervision ..	4.82	4.91	4.63	2.29	3.11	4.57	1
	Cultivation :							
2	"Supplying" Cacao Trees ..	.51	.68	.97	.25	.43	.96	2
3	Trimming and Pruning Trees..	1.44	1.85	1.99	.68	1.17	1.96	3
4	Cutlassing and Weeding ..	2.49	3.06	4.08	1.18	1.94	4.02	4
5	Draining and Roundridging ..	.61	.93	1.02	.29	.59	1.01	5
6	Applying Manure	.15	.38	.55	.07	.24	.55	6
7	Pests and Diseases ..	.23	.21	.17	.11	.13	.17	7
8	Miscellaneous Cultivation ..	.14	.14	.19	.06	.09	.18	8
9	Total Cultivation ..	5.57	7.25	8.97	2.64	4.59	8.85	9
10	Reaping	3.06	2.52	2.03	1.45	1 60	2.01	10
11	Manufacture	1.06	.86	.59	.50	.55	.58	11
12	Live Stock	1.11	1.09	1.05	.53	.69	1.04	12
13	Buildings	.75	.93	1.07	.36	.59	1.05	13
14	Taxes	.54	.62	.69	.26	.39	.68	14
	Estate Supplies :							
15	Manures	..	.08	.24	..	.05	.23	15
16	Feed	.34	.43	.45	.16	.27	.45	16
17	Other	.60	.79	.79	.29	.50	.78	17
18	Total Supplies	.94	1.30	1.48	.45	.82	1.46	18
19	Miscellaneous	.15	.25	.25	.07	.16	.25	19
20	Roads and Bridges	.26	.37	.30	.12	.23	.30	20
22	Total Cost	18.26	20.10	21.06	8.67	12.73	20.79	22
23	Revenue from Inter-cultivated crops	.14	.44	.60	.07	.28	.60	23
24	Cost on Estate	18.12	19.66	20.46	8.60	12.45	20.19	24
25	Transport to Merchant's Store ..	.73	.56	.33	.35	.36	.32	25
26	Cost at Merchant's Store ..	18.85	20.22	20.79	8.95	12.81	20.51	26
29	Revenue from Cacao	38.71	29.17	19.03	18.38	18.48	18.77	29
30	Profit on Cacao	19.86	8.95	..	9.43	5.67	..	30
31	Loss on Cacao	..	..	1.76	..	..	1.74	31
32	Other Expenditure	.69	2.27	4.22	.33	1.44	4.17	32
33	Other Revenue	.92	3.07	5.24	.44	1.94	5.18	33
34	Total Expenditure	19.54	22.49	25.01	9.28	14.25	24.68	34
35	Total Revenue	39.63	32.24	24.27	18.82	20.42	23.95	35
36	Profit	20.09	9.75	..	9.54	6.17	..	36
37	Loss	..	..	.74	..	..	.73	37
38	Interest Received	..	.02	.02	..	.01	.02	38
39	Interest paid	3.85	2.02	.59	1.83	1.27	.58	39
40	Net Profit	16.24	7.75	..	7.71	4.91	..	40
41	Net Loss	..	..	1.31	..	..	1.29	41
		Total.			Average.			
42	Cacao Acreage	8,409	32,220	8,916	271	256	288	42
43	No. of Cacao Pickets in 1,000's ..	2,403	8,945	2,443	77	71	79	43
44	Valuation in 1,000's $	2,124	7,667	1,503	68	61	48	44
45	Yield in bags of Cacao ..	17,710	50,869	9,030	571	404	291	45
46	Yield in bags per 1,000 pickets ..	..	..	..	7.37	5.69	3.70	46
47	Yield in lb. per acre	..	..	..	347	260	167	47
48	Yield in lb. per picket	..	..	..	1.22	.94	.61	48
49	Price of Cacao per fanega in $ ..	..	..	..	12.25	12.32	12.52	49
50	Per cent. return on capital ..	..	..	..	7.96	4.10	(loss) .44	50
51	No. of estates surveyed ..	31	126	31	..	..	..	51

NOTES ON TRINIDAD FUNGI.

I. PHYTOPHTHORA.

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1. Introduction.

These notes have been compiled from data accumulated during the past few years in the course of investigations on the gummosis disease of citrus trees and the black-pod disease of cacao. The first two species to be discussed, *Phytophthora palmivora* and *Phytophthora parasitica*, have been known in Trinidad and other West Indian islands for many years, but the third species, placed tentatively in the '*arecae-meadii*' group of this genus, is apparently a new record for the West Indies. Until the systematic relationships of this fungus have been more certainly determined it will be referred to as '*Strain C*'. Identification of species in the genus *Phytophthora* is notoriously difficult, and the writer is indebted to Mr. S. F. Ashby, Director of the Imperial Mycological Institute, for the identifications given in this article.

Species in the genus *Phytophthora* are often ill-defined and have few reliable morphological or other characters by which they may be differentiated. Some temperate species such as *Phytophthora infestans* and *P. erythroseptica* have a fairly limited range of host plants, a factor rendering their identification simpler, but most of the tropical forms are more or less omnivorous, and inoculation experiments are of little value in the identification of species although they furnish the chief means of distinguishing the various biologic forms. Some species contain several biologic forms or strains as they are sometimes called, and systematists are by no means in agreement as to the limits of some of the closely related tropical species. Certain American workers, notably Leonian (8) have merged several of the species, in particular *P. parasitica*, *P. arecae* and *P. meadii* into *P. palmivora*, but the writer prefers the view of Ashby (1) and Tucker (10) that the specific entities of *P. palmivora* and *P. parasitica* at any rate should be maintained. *P. arecae* and *P. meadii* are closely related but further research is required before their systematic position can be determined.

2. Phytophthora palmivora, *Butler.*

P. palmivora has been known in Trinidad for many years as the cause of black-pod and canker of cacao, two of the most serious diseases of this crop. Full accounts of its history and taxonomy have been given by Butler (4), Von Faber (11), Ashby (1), Rorer (9), Gadd (6) and others. Originally the *Phytophthora* attacking cacao was known as *P. faberi*, Maubl., but it was soon realised that this organism was morphologically identical with the previously described *P. palmivora*, Butler, the cause of bud-rot of palms in India and elsewhere (4). They were therefore united as biologic forms of the one species and the older name *P. palmivora* retained. It has recently been shown by the writer in Trinidad (3) and by workers in other countries that there are other biologic forms of this species capable of causing both gummosis and fruit rot of citrus. An account of this work is given by Fawcett (5) in the second edition of his book " Citrus Diseases and Their Control ".

Phytophthora palmivora can be readily obtained in pure culture from diseased cacao pods and less easily from cacao cankers. The 'citrus' form is very rare as a cause of gummosis but is fairly regularly found as a fruit rot of grapefruit when the fruit begins to ripen in November and December towards the close of the rains. Citrus fruit-rots caused by *Phytophthora* species, however, are rare in Trinidad and as yet of no commercial importance. The tropical species of *Phytophthora* are in general fairly easy to grow in pure culture and the simple technique described below has been used successfully in obtaining isolations from decaying fruits, gummosis and canker lesions, and from 'damping off' seedlings.

Small pieces of infected material from the periphery of diseased areas, surface sterilized with mercuric chloride in the case of the seedlings, and taken from the inner tissues when dealing with gummosis and canker lesions or fruit-rots, were placed on two per cent. plain agar in petri dishes. After two or three days at tropical temperatures the fungus had grown out from the piece of tissue about half an inch on to the agar, and pure cultures were easily obtained. Potato-sucrose-agar slopes or potato blocks were used for stock cultures. It was found that greater freedom from bacterial and other contaminations was obtained when using plain agar than with any nutrient agar in the petri dishes, and, moreover, that the organisms could readily be recognised on this medium since all three species produced sporangia on it abundantly in three of four days. Figs. 1, 2 and 3 were drawn from such cultures examined directly with the low power of the microscope. The sporangiophores of the species under consideration are very delicate and easily deranged by handling. Considerably better results were obtained from this direct observation of the petri dishes than by the examination of small sections of colonies teased out into water in the usual way. Fig. 1 shows the prominently papillate sympodial sporangia of the morphologically identical 'cacao' and 'citrus' forms of *P. palmivora*. They are

FIG. I.—SPORANGIA OF *Phytophthora palmivora*, BUTLER. A, A1 'CITRUS' STRAIN, B, B1, 'CACAO' STRAIN.

FIG. II.—SPORANGIA OF *Phytophthora parasitica*, DASTUR. A FROM COTTON, B FROM CITRUS, C FROM TOBACCO.

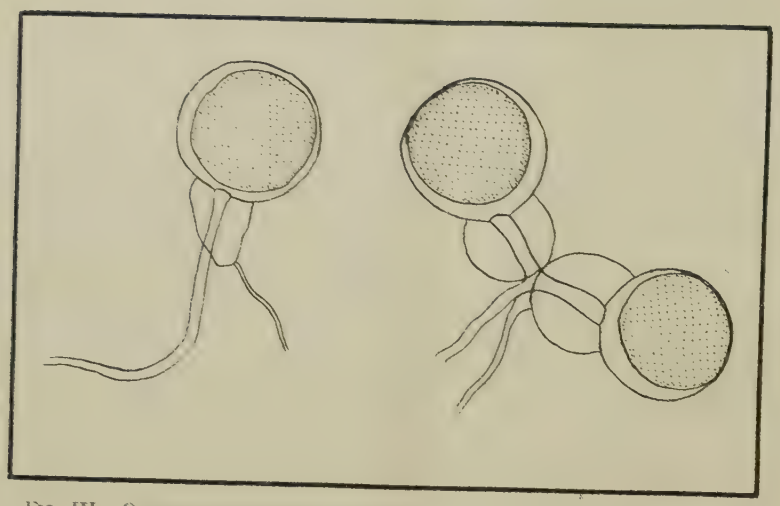

FIG. III.—OOGONIA, AMPHIGYNOUS ANTHERIDIA AND OOSPORES OF *Phytophthora parasitica*, DASTUR

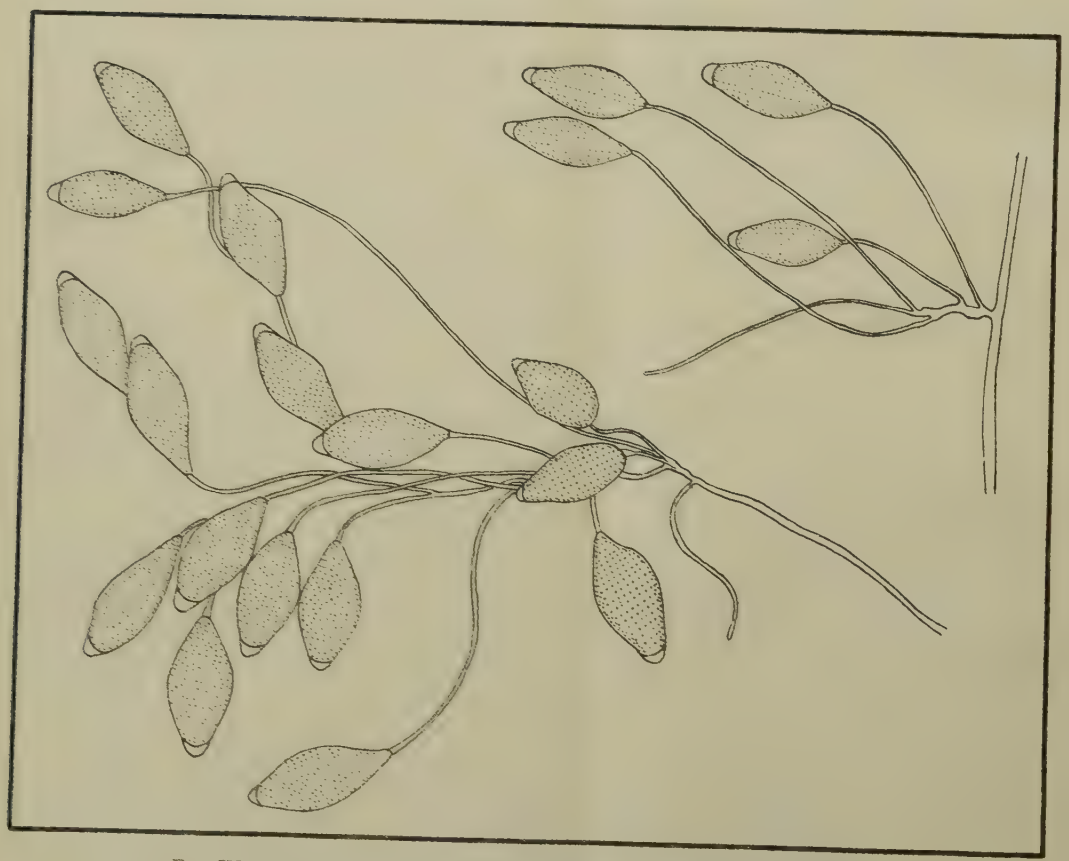

FIG. IV.—SPORANGIA OF *Phytophthora* SP. (*arecae-meadii* GROUP) STRAIN C FROM CACAO.

produced in great abundance on cacao pods in wet weather and in culture on potato-sucrose-agar and other rich media at tropical temperatures. The dimensions of the sporangia vary considerably; from 34-68μ (mean 50.5μ) in length, and 23-45μ (mean 31.5μ) in breadth; ratio length/breadth 1.6.

Liberation of zoospores can be induced by placing the sporangia in well aerated water at about 22°C. as described by Gadd (7) in Ceylon. In Trinidad the temperature often falls to 22°C. (71.5°F) at night and zoospores are liberated readily. In an experiment started at 8.30 p.m. (temp. 24°C) motile zoospores appeared after 30 minutes, remained motile about 8 minutes and had begun to germinate by 9.35 p.m. (temp. 22.5°C). It seems probable therefore that most of the infection of cacao pods in the field is by zoospores liberated in dew or rain at night and not by the direct germination of sporangia, which takes place at higher temperatures. Efforts to obtain oospores in mixed cultures with *Phytophthora parasitica* have so far failed and none have been observed either in pure cultures or on natural substrata.

Cross-inoculation experiments demonstrated the difference in pathogenicity between these two forms. The 'citrus' form proved non-parasitic to green cacao pods and only slightly so to ripe pods even when inoculated into wounds, while the 'cacao' form attacked cacao pods of all ages through wounds, and infection could be induced by inoculating unwounded pods with a suspension of zoospores in water. Both forms attack citrus fruit, but while the 'citrus' form produces a virulent type of gummosis on a citrus tree the 'cacao' strain has little or no effect.

3. Phytophthora parasitica, *Dastur.*

Phytophthora parasitica is very common in Trinidad. Nearly all the gummosis of citrus trees in the island can be attributed to it since *P. palmivora* is rare in this connection and *P. citrophthora* has never been found. Isolations have also been obtained from citrus fruit, 'damping-off' citrus and cotton seedlings and from tobacco plants affected by the 'black shank' disease. The isolations obtained from citrus and cotton were obviously identical, but the tobacco isolations showed certain small differences which cannot be described here and it is possible that this is the 'variety *nicotianae*' of Tucker (9). Other authorities however regard this variety as a biologic form of *P. parasitica*.

Sporangia of this species (Fig. 2) are produced on exceedingly delicate sporangiophores in a much less regular arrangement than in *P. palmivora* and are more nearly spherical. They are exceedingly variable in size and measure 34-60μ (mean 48μ) in length and 30-49μ (mean 38μ) in breadth, ratio length/breadth 1.2. As in *P. palmivora* liberation of the zoospores can be effected by placing the sporangia in water at 22°C. These are similar in appearance and size to those of *P. palmivora*. Oospores (Fig. 3) are formed sparingly in pure culture on lima-bean agar and abundantly on this medium in mixed cultures with *P. palmivora*. The oogonia and oospores are spherical, measuring 19.5-28.6μ (mean 22.7μ) and 15.6-24.7μ (mean 18.9μ) in diameter respectively and therefore belong to the 'Microspora' group of the species. In his study of this species Ashby (2) found that if the dimensions of the oospores are considered the various strains could be divided into two fairly sharply defined groups, according to their size, which he named 'Microspora and 'Macrospora'. Oospores in the first group measure 12-24μ (mean less than 20μ) in diameter and in the second group 20-35μ (mean greater than 20μ, and 25-30μ in the known strains). Isolations from both groups have been described from Trinidad and other West Indian Islands, but so far only oospores belonging to the group 'Microspora' have been noted in these investigations.

4. Phytophthora sp. (arecae-meadii group). 'Strain C'.

This interesting strain has been obtained on several occasions from diseased cacao pods in different parts of the island, the symptoms produced on cacao pods being identical with those of *P. palmivora*. Until a definite identification of this fungus is obtained it will be referred to as '*Strain C*'. Work on this subject is now in progress at the Imperial Mycological Institute. It must be realised at the outset that this record does not in any way constitute a 'new disease' of cacao. This strain has in all probability existed in Trinidad for many years but was not discovered until work involving the identification of many isolations from diseased cacao pods was undertaken. The object of this work was to determine whether *Phytophthora* black-pod disease was caused by one strain only of *P. palmivora*, or, as was thought possible, by several biologic forms or even species of *Phytophthora*, including *P. parasitica*. *P. parasitica* was not found in nature, though cacao pods can be infected with certain strains of this species artificially, but isolations of this new strain were obtained from four districts. Out of a total of 663 diseased pods examined, 356 (54 per cent.) were infected by the typical 'cacao' strain of *P. palmivora*, 22 (3 per cent.) by this '*Strain C*', and the remainder by other fungi including *Botryodiplodia theobromae* (32), *Dothiorella ribis* (121), *Ceratostomella fimbriata* (14), *Colletotrichum gloeosporioides* (31) and unidentified species of *Colletotrichum*, *Phomopsis* (12) and *Fusarium*.

Isolations were made at all seasons and the somewhat low percentage of *P. palmivora* obtained may be accounted for by the fact that while this fungus predominates as the cause of pod-rot in the wet season, it occurs less commonly in the dry season. Other pod-rotting fungi, especially *Dothiorella ribis* and the common anthracnose

fungus, *Colletotrichum gloeosporioides*, are more noticeable at this time. *Botryodiplodia theobromae* occurs commonly on wounded pods, especially those damaged by rats or by carpenter birds. Unfortunately the main cacao crop is set and matures on the trees during the wet season and it is at this time that *P. palmivora* causes such serious losses, and the collective damage done by other pod-rotting fungi is insignificant when compared with that done by this fungus. Any treatment designed to control *P. palmivora* is likely to have a similar effect on '*Strain C*'.

The sporangia of '*Strain C*' (Fig. 4) are produced sympodially as in *P. palmivora*, but differ in that they are formed on much longer pedicels and have a much greater length/breadth ratio. The sporangia measure 30-60μ (mean 47μ) in length and 15-34μ (mean 21μ) in breadth: ratio length/breadth 2.2. They are formed abundantly at tropical temperatures on potato and lima-bean agars and on the surface of infected cacao pods. Zoospores are liberated readily in water at 22°C. and remain motile for at least an hour, much longer than those of *P. palmivora* at this temperature. At higher temperatures they remain motile for shorter periods, which are however correspondingly longer than those of *P. palmivora*. In size they are similar to those of *P. palmivora* and *P. parasitica*. Oospores have so far not been found in nature, in pure culture or in mixed cultures with all available forms of *P. palmivora* and *P. parasitica*. In mixed cultures '*Strain C*' in addition to forming no oospores itself does not stimulate either *P. palmivora* or *P. parasitica* to form oospores indicating that it is not as closely related to either of these species as they are to each other.

Inoculation experiments with this fungus show that the zoospores are capable of infecting unwounded cacao pods. Many strains of *Phytophthora* can attack cacao pods through wounds but until this organism was discovered the only strains known to attack unwounded pods were the 'cacao' strains of *P. palmivora*. It also attacks citrus fruit in a manner comparable to *P. parasitica* and *P. palmivora*.

Summary.

A new strain of *Phytophthora* causing a pod rot of cacao identical with that caused by *P. palmivora* is described. It is emphasised that the strain has probably existed in Trinidad for many years and its discovery is of little economic significance in the control of cacao diseases.

Brief notes are given of other *Phytophthora* species found on cacao, cotton, citrus and tobacco.

References.

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REVIEWS.

FOREST BIBLIOGRAPHY TO 31ST DECEMBER, 1933.

Part I. Compiled and published by the *Department of Forestry, University of Oxford*, Oxford, 1936, pp. 78.

In the Preface to this Bibliography, Professor Troup stresses the fact that at the outset the sole object of the systematic referencing of current forest literature begun by the Oxford School of Forestry in 1920 was to provide the staff and students with facilities for keeping in touch with the latest literature bearing on forestry, for which purpose a simple system of classification was devised: there was, until recently, no intention of publishing the Bibliography, otherwise it might have been prepared on different lines.

The Bibliography contains a list of the periodicals, bulletins, reports and other material to be found in the library of the Imperial Forestry Institute, Oxford, but does not include any mention of the books contained in the library. A considerable amount of literature published in French and German is included.

The present volume starts with a list of abbreviated titles used. This is followed by a table showing the subject classification which forms the basis of the Bibliography: the decimal system of classification is only being adopted, however, for publications issued on or after 1st January, 1934. The remainder of the volume is occupied with the commencement of the bibliography proper and contains the following

subjects :— A. — General Forestry subdivided into geographical sub-heads : B.—Silviculture : 1. General : 2. Seed and seedlings.

All publications referred to in the bibliography are available for consultation in the library of the Imperial Forestry Institute. This publication will prove a valuable guide to all who are interested in forest literature.

R. L. B.

* * *

VITAMINS IN THEORY AND PRACTICE.

By L. J. Harris, sc.d., d.sc., *University Press*, Cambridge, 1935. pp. 240, price 8*s.* 6*d.*

The rapid development during recent years of our knowledge of the vitamins or accessory food factors as well as the increasing popularity of the subject, has inspired the publication of a large number of books on vitamins ranging from biochemical treatises to the popular accounts that have done so much to awaken a world-wide interest in dietics. The book under review forms the subject matter of a series of four lectures delivered by Dr. Harris at the Royal Institute in London in 1934. It is a readable narrative in non-technical language of the history of the discovery of the vitamins, and it is primarily intended for the general reader.

Although it has long been known that diseases such as scurvy (1720) beri-beri (1882) and rickets (1890) are due to dietary errors, it was not until after 1912 that the real explanation was found. The discovery of vitamins was a gradual process, one development slowly merging into another. The course of these developments is traced in the first chapter of the book, and credit is given to the many scientists who have been responsible for them. Next, a brief account is presented of the various vitamins so far discovered (vitamins A, B_1, B_2, C, D, E, and the "bios" of yeast). This is followed by separate chapters devoted to the different vitamins considered in detail. Throughout, the historical aspects of the discovery of the nature and identity of each vitamin are stressed which gives a strong humanistic interest to the narrative. This interest is sustained by numerous photographic reproductions, diagrams, charts and tables, as well as by frequent summaries and recapitulations of the main conclusions. Even the experimental difficulties and mistakes that have cropped up during the course of the vitamin investigations are not evaded, so that a clear picture of the scientific method and the great difficulties of research is impressed on the mind of the reader. The last chapter concerns dietics. It stresses the fact that, in deciding what to eat instinct alone is not an infallible guide, but that we need to be educated about nutrition.

F. H.

THE STUDY OF THE SOIL IN THE FIELD.

By G. R. Clarke. *Clarendon Press*, Oxford, 1936, pp. 142, 2*s.* 6*d.*

This little book is the only simple guide to the accurate description of the soil profile known to the reviewer, and its publication supplies a real need. Its author is lecturer in the Department of Rural Economy of Oxford University, and it is issued under the auspices of the Imperial Forestry Institute, Oxford.

Mr. Clarke has made a special study of the features which soil profiles display in the field, and has endeavoured to put together his own experience, in such a way as to be of assistance to students, officers of agricultural and forestry departments, farmers, and others who may be concerned in the investigation, description and recording of the characters of soil profiles as they appear in nature.

The subject matter is divided into five chapters. The first chapter deals with the broad description of the soil site and the soil profile. It contains examples of methods of stating and recording observations made on the spot, as well as laboratory results obtained later. It includes descriptions of the climate, the nature of the parent rock material, the incident vegetation, the degree of maturity and mode of development of the profile, and the topography of the site. Chapter II concerns the detailed recording of the features of the various layers or horizons that comprise the soil profile. An important feature of the treatment of this subject is the valuable suggestions offered for the exact description of soil colour, texture, structure, consistence, porosity, and tenacity. Suitable terms are proposed for expressing these factors ; the need for a uniform nomenclature is rightly stressed.

Chapter III fully describes a tested procedure for collecting soil monoliths or slabs of soil which can be cut from the natural profile, mounted and fixed in shallow boxes, and set up in the soils museum for purposes of reference and comparison.

Chapter IV briefly discusses soil surveying and mapping, and the last chapter considers the main attributes of certain systems of soil classification and mapping, with examples of methods employed in Russia, certain European countries, the United States of America, Scotland and England. The text is illustrated with numerous tables and some diagrams, and an index of the main topics concludes the book.

F. H.

The Editor requests that any subscriber who fails to receive *Tropical Agriculture* regularly should communicate with him immediately in order that the matter may be rectified.

SUGAR NOTES.

Compiled by the College Department of Sugar Technology.

Sugar Determination (in Biological Solutions) by the Ferricyanide Electrode. *By P. A. Shaffer and R. D. Williams.*

Alkali ferricyanide is in some respects an ideal oxidant for the determination of reducing sugars. Stable in alkaline solution, it is reduced by sugars to a stable soluble reductant (ferrocyanide) unaffected by atmospheric oxygen. The quantity reduced may be found by colorimetric measurement or by the time period required for reduction. But another simple and convenient method is the measurement of the electrical potential of a platinum wire immersed in the solution—the well-known ferri-ferrocyanide electrode. If the sum of the ferri- and ferrocyanide concentrations is known, and certain constants are established for the particular solutions and conditions used, the measured potential indicates the quantity of ferricyanide reduced, from which the quantity of sugar oxidised may be calculated. Working in this way with blood filtrates, the authors found that, providing interfering substances are absent, satisfactory results are easily and conveniently obtained over a wide range of sugar concentrations. It would appear worth while examining the possibilities of this method for application to sugar-house routine practice.—(*Inter. Sugar Journal*, Vol. XXXVIII, No. 452, p. 311, 1936.)

* * *

Improved Yields in British Guiana. *By J. A. Dash.*

During the period 1920-1930, the country's average yield per acre was approximately 2.00 tons of sugar, while for 1930-1935, it was 2.60 tons per acre compared with 3.00 tons for 1935 alone. These average figures embrace several ratoon crops as well as plants.

Of this increased yield of 50 per cent. over the 10-year period above mentioned, about 12 per cent. may be attributed to factory improvements in recent years, the remaining 38 per cent. almost entirely to field improvements. This is due to a number of factors : a better understanding and increased use of flood-fallowing and irrigation; the rapid extension of the cane varieties, Diamond 10 and P.O.J. 2878; and a better adjusted fertilizer policy.

Further improvements will come from better pest control. The Amazon fly (collected by Dr. J. G. Myers in the Amazon valley) has established itself in the coastlands, and gives a fair promise of success in control of moth borer. This remarkable fly, instead of eggs, lays active young, as many as 500 at a time. These tiny white maggots hardly visible to the naked eye are deposited near the entrance of the burrows of the cane borers, and are guided by instinct towards their host, the maggot penetrates the skin, attaching itself on the inner surface, and in a few days kills the borer. A fortnight later there emerges from the burrow of its host the adult Amazon fly ready to mate and propagate itself.

In the laboratory, the breeding work necessitated the actual dissection and removal of the live maggots from the females, and depositing them on the caterpillar larvae of the borers which were then replaced in cane shoots to continue development, altogether a somewhat delicate operation, requiring a definite technique coupled with dexterity and precision on the part of the operator.—(*Int. Sugar Jr.* Vol. XXXVIII, No. 452, p. 312, 1936.)

* * *

Methods of Juice Analysis in Soil Fertility Investigations. *By N. McKaig, Jr. and L. A. Hurst.*

A description is given of analytical methods employed by the Division of Soil Fertility Investigations of the U.S. Department of Agriculture on its work in the Louisiana cane districts. Since numerous preliminary tests showed that differences in juice composition, due to fertilization, soil, &c., are reflected in both crusher and whole-mill juices to essentially the same extent, the investigations are conducted entirely on crusher juice; equal volumes of crusher juice from each replication are composited to give representative samples from each fertilizer treatment from each location. Removal of extraneous solids from the juice is accomplished by a standardized centrifugal technique combined with screening (centrifugal force 2,300 times gravity, with subsequent screening through a 200 mesh sieve). Apparent total solids, apparent and true sucrose, and total nitrogen are determined by usual methods, reducing sugars according to Lane and Eynon, ammonia and nitrate nitrogen by the Sessions method, pH and acidity by the electrometric method (quinhydrone), ash by ignition, and chlorides by a modification of the Pellinger method.—(*Facts about Sugar*, Vol. XXXI, No. 4, p. 150, 1936.)

* * *

Rotary Screens for Raw Cane Juice. *By B. H. Blanco.*

The author discountenances the prevailing opinion that an efficient system of rotary screens for removing bagacillo from the raw cane juice will lead to the supression of the expensive filter press station. It is not denied that good screening contributes much toward obtaining a clean juice; but even double straining through screens with as many as 6,400 holes to the square inch still leaves enough bagacillo in the juice to create trouble. Even when using the Petree process in conjunction with the Dorr clarifier it is advisable to use efficient screens.—(*Facts about Sugar*, Vol. XXXI, No. 4, p. 146, 1936.)

IMPERIAL COLLEGE OF TROPICAL AGRICULTURE.

COLLEGE NEWS BULLETIN

DECEMBER, 1936.] [No. 2.

COLLEGE NEWS.

IN MEMORIAM

HARRY RICHARD BRITON-JONES
D.Sc., Ph.D., D.I.C., A.R.C.S.
for ten years
Dean and Professor of Mycology and Bacteriology
Imperial College of Tropical Agriculture
Died
Tuesday, 3rd November, 1936

* * *

The Principal, accompanied by Lady Evans returned to Trinidad by s.s. *Simon Bolivar* on 29th October.

* * *

Mr. G. C. Taylor, Principal of the Mabang Agricultural School, Sierra Leone, stayed for some time at the College in order to familiarise himself with its activities.

* * *

Sir Cecil Hanbury, M.P. and Mr. Eric Macfadyen have been reappointed for a further term of four years on the Governing Body of the College.

* * *

Sir Edward Davson, Bart., K.C.M.G., has been reappointed as British Guiana's representative on the Governing Body of the College.

* * *

We extend our sympathy to Mr. R. F. Innes who is lying ill in a nursing home in Port-of-Spain as a result of an operation, and wish him a speedy recovery.

* * *

Dr. C. W. Wardlaw, Officer in Charge of the Low Temperature Research Station, represented the College at the International Congress of Refrigeration which was held this summer in the Hague and Amsterdam.

* * *

The late Dr. H. R. Briton-Jones and Dr. C. W. Wardlaw represented the College at the Second International Congress for Microbiology which was held this summer in London.

The late Dr. H. R. Briton-Jones, Professor of Mycology and Bacteriology and Mr. D. D. Paterson, Reader in Agriculture accompanied by Mrs. Paterson returned to Trinidad by M. V. *Colombia* on 17th September.

* * *

The College Staff and Students extend their congratulations and good wishes to Mr. R. G. Fennah, on the event of his marriage to Miss E. M. A. Wellings which took place at All Saints Church, Port-of-Spain, on 8th September.

* * *

Mr. R. C. Wood, Professor of Agriculture, Mr. E. E. Cheesman, Professor of Botany and Genetics and Dr. J. R. Dickson, Medical and Health Officer and Mrs. Dickson, returned to Trinidad by the s.s. *Venezuela* on 3rd October.

* * *

Mr. G. A. Jones, Commissioner of Agriculture and Mrs. Jones and Dr. C. W. Wardlaw, Officer in Charge, Low Temperature Research Station, and Mrs. Wardlaw returned to Trinidad by s.s. *Costa Rica* on 14th October.

* * *

Mr. G. G. Gianetti, Registrar and Editor-Librarian and Mrs. Gianetti; Mr. J. G. Davies, Sugar Technologist, and Mrs. Davies; Dr. D. W. Duthie, Lecturer in Chemistry and Mr. E. R. Leonard, Plant Physiologist, Low Temperature Research Station, returned to Trinidad by the M.V. *Caribia* on 26th September.

* * *

Among those who recently visited the College were: Mr. Shinji Tasaki, President of the Kobe University of Commerce, Japan; Mr. W. Leach, Labour M.P. for Bradford and Mrs. Leach; Dr. Rogerio de Carmargo, Director of the Technical Service for Coffee, Ministry of Agriculture, S. Paulo, Brazil; Mr. Ernesto Gomez, Brazilian Consul for Trinidad; Mr. Narbal Costa; Commander Alum Jones and Pay-Master Lieut-Commander F. M. Johnson of H.M.S. *Challenger*; Dr. Cuthbert Lockyer, M.D., F.R.C.P., F.R.C.S. and Mrs. Lockyer; Mr. and Mrs. Gordon P. Smith of Guatemala and Mr. Denis Peterkin of Mass., U.S.A.

The Principal was nominated by the Governing Body of the College to attend the Fifth Congress of Universities of the British Empire which was held at Cambridge in the third week of July 1936. Apart from the quinquennial review of the work of the Universities Bureau of the British Empire, many of the subjects were of particular value to educationalists. The discussion on careers for students was of interest as showing the modern tendency for university students to be absorbed in commerce and industry. The Principal submitted a paper with particular reference to careers in tropical agriculture. A striking address was delivered by the Rt. Hon. Stanley Baldwin in his capacity as Chancellor of Cambridge University in which he pleaded for a return to the studies of the arts which tended to be neglected for the sciences In this connection he suggested that Cambridge might do well to turn out more poets. The Cambridge University authorities maintained to the full their well known tradition for hospitality.

* * *

The Principal was nominated by the Colonial Office, with the consent of the Governing Body, to represent the West Indies group of Colonies at the British Commonwealth Scientific Conference. The chief object of this Conference was to review the work of the various Bureaux and Research Institutions that come under the aegis of the Imperial Agricultural Bureaux. These are maintained on a contributory basis by all the Governments of the British Commonwealth of Nations and each Government therefore sent one or more delegates to attend the Conference. The Conference commenced on 21st September, and the first fortnight was spent in visiting the various Bureaux and Research Institutes controlled by the Executive Council. The last week was spent in conference at Burlington Gardens, London. Various recommendations were submitted to the several Governments for their consideration, among the most important perhaps being proposals to initiate two new Bureaux, one for Forestry and the other for Dairying.

COLLEGE SESSION, 1936-37.

The 1936-37 Session began on 5th October with the following students in residence:—

DIPLOMA STUDENTS.

1st Year.

K. G. Proverbs (Barbados); L. H. Lord (British Guiana); W. Ryle Davies (England); J. Huc (France); J. G. Smith (Guatemala); B. N. Ray (India); T. Chinloy, D. P. S. Delgado, M. D. ffrench-Mullen and E. D. Weller (Jamaica); H. T. Carrington (Montserrat); H. H. Beach and H. T. Foster (St. Kitts); W. A. Flook, W. A. Rose and M. S. Sampath (Trinidad); R. T. Hernandez and C. M. Salazar (Venezuela).

2nd Year.

O. F. J. Churaman (British Guiana); W. G. Stuart (Jamaica); P. J. Sauvage (Seychelles); F. O. Gonzales (Trinidad).

3rd Year.

W. R. E. Nanton (Antigua); E. R. H. Martin (Grenada); D. L. Foster and O. C. Henriques (Jamaica); A. O. Harris, I. Hosein and K. M. Houlder (Trinidad).

3rd Year Sugar Technology.

D. M. Khandke (India).

4th Year Sugar Technology.

A. C. Gomez (Trinidad); R. S. Patel (India).

Colonial Office Scholars.

M. Akenhead, B.Sc. (Agric.), Wye.
E. F. Allen, B.A. (Hons.) Cambridge.
G. D. Badger, B.Sc. (Hons.), Reading.
W. E. T. Bond, B.A., (Hons.) Cambridge.
A. P. S. Forbes, B.Sc. (Hons.), Edinburgh.
D. M. Hanschell, B.Sc. (Hons.), Edinburgh.
R. F. Innes, B.A. (Hons.), Wales.
A. B. Lucy, B.Sc. (Hons.), London.
A. F. Posnette, B.A. (Hons.), Cambridge.
D. H. Welch, B.Sc. (Hons.), St. Andrews.

Refresher.

E. L. Hay, B.Sc. (Hons.), Glasgow, (Gold Coast.)

Special.

C. G. Munro (Grenada); E. P. Schonbeck (Germany).

EXAMINATION RESULTS, 1935-36.

YEAR I.—The following candidates satisfied the examiners in the first year examinations for the Diploma and have proceeded to the 2nd Year course:—

O. F. J. Churaman. P. J. Sauvage.
F. O. Gonzales. W. G. Stuart.

YEAR II.—The following candidates satisfied the examiners in the second year examinations for the Diploma and have proceeded to the 3rd Year course:—

D. L. Foster. I. Hosein.
A. O. Harris. K. M. Houlder.
O. C. Henriques. E. R. H. Martin.
W. R. E. Nanton.

YEAR III.—The following candidates satisfied the examiners in the third year examinations for the Diploma and have been awarded the Diploma of the College :—

W. K. M. Mitchell.
A. C. Gomez (Sugar Tech.)
R. S. Patel (Sugar Tech.).

COLLEGE SPORTS.

Rugby 1935-36.

The Rugby season was unfortunately shorter than usual owing to a late start and to the visit of a Demerara touring team. Our total playing strength numbered seventeen, many of whom are to be congratulated for turning out again after a lapse of many years from active football.

The record of the games played was very satisfactory but in many of the matches the score was no criterion of the run of play. A presumably stronger fifteen would often score many points in the first few minutes of the game only to find that the College side was not content with defence but would actually attack, the result being an even game for three-quarters of the match. The same result but at a different stage was achieved against a weaker side, when after an even game into the second half, the College would score freely in the final ten minutes. The two games with the South were good examples. On 10th November, the South scored first and the College put up most of the 16 points at the end of the game. In the second match at Pointe-a-Pierre, which was most enjoyable, the South scored 11 points in the first half and were unable to score in the second half whilst the College recorded a try.

At full back we were fortunate in finding a player who, though new to the game, played like a veteran. The threes combined speed with a certain amount of football ability but frequently lacked aggression. The halves' were extremely solid in defence and did not fail to open the game when possible. The forwards excelled in the loose and were ready to back up three-quarter movements. They suffered in formation from lack of practice.

Team:—Fullback, B. de L. Inniss; Three-quarters, G. R. Langdale, O. M. Henriques, C. W. R. McCreary, R. D. E, Yearwood; Halfbacks, A. C. Gomez, D. R. N. Brown; Forwards, C. E. Johnson, H. M. James, C. H. F. Walker, R. E. D. Baker, S. Duncan, E. R. Leonard, J. W. Purseglove and A. R. Melville. J. M. Watson and Tom Bell each played in two matches.

Date.	*Opponents.*	*Points for.*	*Against.*	
Oct.				
17th	*v.* T.N.R.F.C. (Home) ...	12	5	won
24th	*v.* Caribbeans (Port-of-Spain)	5	3	won
Nov.				
10th	*v.* S.R.F.C. (Home)	16	3	won
21st	*v.* T.N.R.F.C. (Port-of-Spain)	6	15	lost
24th	*v.* S.R.F.C. (Pointe-a-Pierre)	3	11	lost
Dec.				
1st	*v.* Caribbeans (Home)	6	3	won

Played 6 matches, won 4, lost 2, points for 38, against 40.

* * *

Rugby 1936-37.

The 1936-37 season has opened quite successfully. There have been more players to draw on this year than last and the XV shows every promise of being a particularly good one. The first match of the season against a scratch Port-of-Spain side was won 18—0. This was followed by a drawn match with the Caribbeans on 21st October (no score), and victories over the Crabbacks on 25th October (12—0), the Caribbeans on 28th October (6—3) and again over the Crabbacks on 7th November (19—0). Thus the record to date is excellent and we hope that it will be maintained in the matches which still have to be played against the Trinidad Northern and Southern Rugby Clubs. A. C. Gomez who has played regularly for the College during the past three years is Captain of the XV.

* * *

Hockey 1935-36.

The season was one of "ups and downs", and the match record not so good as it might have been. Altogether fifteen matches were played, six won and nine lost. This, however, is not a fair estimate of our true strength, as in view of conflicting activities and slight injuries to one or two players, the full College side was only out on one occasion. Arrangements were made for weekly practices which appeared to be very popular.

Usually, the high lights of the hockey season are the Staff *v.* Students match, and the Knock-out competition in Port-of-Spain. The former was a great success, and a new innovation was tried, namely, the division of the game into " quarters " instead of " halves ". This allowed the staff " reserves " to be brought in more often. Towards the end of the game the staff seventeen began to tire, and the students won 5-3 (in spite of Professor Shephard's noble " full dress " effort during the last few minutes of play.) The College won the Knock-out competition, beating the Shamrock Club in the final by two goals to one.

The team consisted of the following :— C. E. Johnson, S. Duncan, R. E. D. Baker, B. de L. Inniss, D. R. N. Brown, A. C. Gomez, O. M. Henriques, R. D. E. Yearwood, C. O. Lai Fook, Dr. D. W. Duthie, C. W. R. McCreary.

Professor R. C. Wood very kindly refereed all the matches and practices.

* * *

Golf.

A 9-hole practice golf course was laid out on the College Savannah during the long vacation of 1935. The course covers the land occupied by the various playing fields, the area to the south and west of the tennis courts, a small portion beside the Chemistry Block and, for the 9th green, the triangle beside the Hostel. Hazards are provided by the roads, trees and buildings. A driver may be used by the hardest hitter at five holes. Holing-out is the rather novel method of getting the ball within two feet of the hole, the distance being determined by the length of the pin.

The popularity of the course being proved without question a competition was arranged during the early part of 1936, the prize, a silver spoon, being generously provided by Miss Wood. The competition was over 18 holes against handicaps and only three clubs could be used during a round. Competitors included the staff and students and was won by Mr. J. A. McDonald with D. R. N. Brown as the runner-up.

It is to be hoped that play will continue so that the players may prove their ability over better known courses.

* * *

Tennis 1935-36.

In the final of the College Singles Handicap Tournament R. E. D. Yearwood (-30) defeated C. C. Skeete (-½30) by 8-6, 6-2, 6-0. E. Martin (-½30 and J. A. McDonald (-30) both reached the semi-finals, the latter being beaten by Yearwood 6-3, 4-6, 7-5 in a very hard match.

OLD STUDENTS' CORNER.

T. Bell (1935-36) is Manager of the Government Stock Farm, Palestine.

* * *

H. M. James (1932-35) is Acting Superintendent of Agriculture, Cyprus.

* * *

C. E. Johnson (1935-36) is an Agricultural Officer in Northern Rhodesia.

* * *

G. K. Argles (1933-34) has gone to Nyasaland as Agricultural Officer.

* * *

E. J. H. Berwick (1934-35) has been appointed Agricultural Officer, Malaya.

* * *

C. C. Webster (1932-33) and C. H. F. Walker (1935-36) have been appointed Agricultural Officers in Nigeria.

* * *

J. M. Waterston (1935-36) has gone to Bermuda as Plant Pathologist to the Agricultural Department.

* * *

W. F. Steven (1933-34) has been appointed Plant Pathologist to the Gold Coast Department of Agriculture.

* * *

F. A. Squire (1930-31) has been appointed Entomologist for cotton pest investigations in the Windward and Leeward Islands.

* * *

W. F. Gwilliam (1930-31) of the Gold Coast Department has gone to Nigeria as Agricultural Superintendent.

* * *

D. R. N. Brown, J. W. Purseglove and J. M. Watson who are all three 1935-36 students have been appointed Agricultural Officers in Uganda.

* * *

F. B. Notley (1929-30) Entomologist, Kenya Dept. of Agriculture, has gone as Entomologist to the Tanganyika Agricultural Department.

Engagement.

We offer our heartiest congratulations to J. H. Gisborne (1934-35) of the Nigerian Department of Agriculture on his engagement to Miss Eyvoll McIntosh of St. Augustine.

Marriage.

Congratulations to T. E. K. Potter (1930-33) on his marriage to Miss Aneli Sonni of Santo Domingo.

Printed by the Government Printer.

CHEMICAL NOTES.

Compiled by the College Department of Chemistry and Soil Science.

Phosphorus Content of Citrus.

In an article published in *Soil Science*, Vol. XLI, pp. 239-257, 1936, Dr. A. R. C. Haas of California presents analytical data for the occurrence of phosphorus in different parts of Citrus trees. In the case of the fruiting organs of the lemon, phosphorus is most abundant in the flowers, and its amount decreases as the fruits set and grow to maturity. The phosphorus contents of the rind and the pulp of lemon fruits are less than those of oranges, and are increased by manuring with sodium nitrate. Mottled Citrus leaves contain more phosphorus than normal healthy leaves. The phosphorus content of healthy leaves is diminished by heavy nitrogenous manuring. The quantity of inorganic phosphorus in Citrus leaves is greater than the sum of organic phosphorus and phospholipin fractions.

* * *

The Heavy Limestone Soils of Cuba. *By A. Bonazzi.*

The heavy limestone soils of Cuba are characterized by a pronounced impermeability (once the soil particles have reached a certain degree of moisture), excessive retention of the moisture so absorbed, and pronounced impermeability to gases. Rain penetrates into and wets these soils only through cracks developed in the dry season. The tenacity with which these soils hold absorbed moisture, is shown by an experiment in which cane was permanently wilted when the residual moisture content was still 48.7 per cent. on the basis of the oven dry soil (temp. 110°C.). The permanent wilting point and the sticky modulus of these soils coincide. —(*Facts about Sugar*, Vol. XXXI, No. 4, p. 150, 1936.)

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Rapid Tests for Soil Fertility.—*By C. R. von Stieglitz.*

The field testing outfit devised by Kerr and King for determining lime requirements is being used with success in a slightly modified form. With respect to other soil constituents, the microchemical tests devised by Morgan for calcium, magnesium, potash, aluminium, manganese, phosphoric acid, nitrates, and ammonia, are used with certain modifications. The speed of these tests is such that one operator should have little difficulty in testing at least 100 samples a day. By the rapid modified phosphate test, soils may readily be classified as low (0-40), medium (40-100), and high (greater than 100), in parts P_2O_5 per million parts of dry soil. The calcium test classified soils as very low, low, fair and good in respect to lime content. The magnesium test closely follows that for calcium, but the groupings are not so well defined. The potash test differentiates between high and low, and is of use chiefly in indicating soils that will not respond to potash fertilizing. The tests for nitrates and ammonia are useful for indicating where field comparisons are desirable. Tests for aluminium and manganese are rapidly performed, and should be of value as indicating the presence of toxic amounts of these substances in a soluble condition. The values for aluminium show a close inverse relation with soil pH, as would be expected, and the test could be used in conjunction with the calcium test as an indication of the lime requirement, but for this purpose the field method for pH is preferable.—(*Facts about Sugar*—Vol. XXXI, No. 4, p. 149, 1936.)

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Wind Erosion in South Australia.

Wind erosion is becoming an increasing danger in the semi-arid regions which form the world's chief granaries. In North America, the Argentine and to a less extent in Russia, the fertile prairie soils are rapidly being swept away as the result of destroying the original grass cover. A similar fate is overtaking vast pastoral regions in South Australia, due to overstocking. The gravity of the situation is revealed in a note by F. N. Ratcliffe, from the Commonwealth Council for Scientific and Industrial Research. The worst erosion has been in the 'bush' country, where twelve drought years have so lowered the stocking capacity that overstocking on established farms is now almost unavoidable. Rabbits have added to the evil, the vegetation cannot recover after grazing and natural regeneration of both shrubs and grasses has virtually ceased. Large areas have become barren deserts, and no measures are available for their reclamation. The evil might be checked by adopting a lower stocking policy; but the only hope for the already denuded areas is to introduce perennial exotic plants capable of stabilizing the large sand drifts, and withstanding rabbits and a very low and uncertain rainfall. The chance of discovering such plants is remote, and even if discovered, "there would remain the problem of their dissemination through vast areas with no regular growing season and an unimproved capital value rarely exceeding 2*s*. per acre".—(*Nature*, Vol. CXXXVIII, No. 3487, pp. 358-59, 1936.)

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Juice Purification with "Collactivit"; *by P. Smit.*

"Collactivit" is the name given to a product obtained by digesting carbonaceous materials, such as sawdust, with concentrated sulphuric acid in an autoclave. After the acid has been washed out, the wet residue is ground in a mill and pumped to the station where it is to be employed. If the product is dried, it loses its activity. "Collactivit" has the properties of a decolorant and when made alkaline, has base-exchanging properties, so that it can remove iron, lime and other metals from solution.—(*Facts about Sugar*, Vol. XXXI, No. 8, p. 308, 1936.)

TREND OF THE MARKETS.

[*The notes below are based principally upon running charts of the prices of the basic grades and upon general statistical information gleaned from contemporary publications and cablegrams and are intended to be a record of movements. An attempt is made, where possible, to indicate the market outlook at the time of going to press, but no responsibility for the accuracy and subsequent truth of such observation is assumed. Unless otherwise stated the prices quoted are spot, London.*]

SUGAR.—Prices on the Home Markets have ranged as follows (c.i.f. per cwt.).

	Foreign.	*Preferential.*
	s. d.	s. d.
24th September	4 2½	7 11¼
1st October	4 3¾	8 0¾
8th October	4 4½	8 0½
15th October	4 6	8 3
22nd October	4 9	8 5¼
29th October	4 10½	8 6¾
5th November	4 10½	8 7½
12th November	4 10½	8 8¼
(*14th November* 1935)	4 9⅜	8 6¾

The market since our last report has enjoyed a period of firmness and activity not experienced for some long time, raw prices showing a rise of about 6*d*. per cwt. While this price improvement may to a greater or lesser degree be attributed to continued international disquiet and to international currency affairs there can be little doubt that it is mainly due to the comparative dearth of suitable offerings of unprotected Raws. In this connection the September Board of Trade returns in the United Kingdom at 109,000 tons indicate an extremely slender reserve of raw stocks while advices from Cuba, the most substantial supplier in the open market reveal that the volume of sugars left available in that country is something below 75,000 tons.

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Cotton.—The following are the official spot prices in pence per lb. of the Liverpool Cotton Association.

	American Mid.	*Egyptian F.G.F. Sakel.*
25th September	6.73	10.15
2nd October	7.02	10.57
9th October	6.86	10.61
16th October	6.99	10.90
23rd October	6.96	11.08
30th October	6.81	—
6th November	6.92	—
13th November	6.71	—
(*15th November*, 1935)	6.77	9.77

Subjected at first to heavy pressure of hedge selling, values declined several points but more recently the market has tended to become stronger as there are indications that hedge selling is coming to an end. The American estimate of the crop at 11,609,000 bales was slightly larger than expected. West Indian Sea Island continues in good demand, but no business has been possible owing to absence of stocks.

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COPRA is a firm market with West Indian f.m.s. valued nominally at £15 10*s*. c.i.f. London.—(*West India Committee Circular*, 22nd October.)

RUBBER.—Quotations for plantation sheet have ranged as follows:—

	Pence per lb.
30th September	7 13-16
7th October	7 7-8
14th October	7 15-16
21st October	7 7-8
28th October	8 1-8
4th November	8 3-8
11th November	
(*13th November*, 1935)	6 5-16

The market, though steady has remained inactive. The effect of the break up of the Gold bloc on the Continent caused a slight fall in prices which, however, was short lived while the fear that Dutch devaluation would bring a sharp fall proved groundless. There has been some good buying from America and the Continent. American consumption for September was 46,330 tons while United Kingdom stocks have fallen below 100,000 tons for the first time since June 1934.

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COFFEE.—Little business reported, continental markets being quiet with cheap offers from countries who have recently gone off the Gold Standard. Blue Mountain sold up to 205*s*. 6*d*. for good bold size but slightly inferior qualities were difficult of sale.

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BANANAS.—There has been a slight decline in the demand, but the price of Jamaicas is unchanged at £18 5*s*. per ton delivered London and £18 nearest station Provinces. Brazilians are slow and quoted at £15 London or £16 Provinces.—(*West India Committee Circular*, 22nd October.)

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LIME PRODUCTS.—*Lime Oil.*—The nominal value of Handpressed remains at 35*s*. per lb., but there is practically no demand. Distilled is unchanged with sellers at 22*s*. 6*d*. per lb. *Lime Juice.*—There is no demand for Concentrated and Raw is unchanged at 2*s*. to 2*s*. 6*d*. according to quality.—(*West India Committee Circular*, 22nd October.)

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COCOA.—During the latter half of October the London Market showed signs of unsettlement and nervousness with a slight decline in prices. The future depends a good deal upon what attitude will be taken by New York interests who have been buying largely lately, and it is left to be seen whether they will be able to start the upward movement again or at least arrest the decline. Latest advices quote Accra at 38*s*. 9*d*. whilst locally the market is very strong and $12.70 per fanega is paid for Plantation Cocoa.—(*By Courtesy of the Cocoa Planters' Association of Trinidad, Ltd.*)